MARCH 1947 25 CENTS

POPULAR MECHANICS MAGAZINE

WRITTEN SO YOU CAN UNDERSTAND IT

REG. TRADE MARK, GREAT BRITAIN, NO. 410426 REG. U.S. PAT. OFF.

ROCKET BRAKES
PAGE 164

THAT CUSHIONY FEELING LASTS LONGER WITH **MARFAK!**

It's a grand feeling to snap good pictures of friends or family with a flash . . . the same grand feeling you get from your smooth riding, *Marfak* lubricated car.

Marfak is scientifically designed to cling to bearing surfaces, resist wash-out, jar-out and squeeze-out and stick to the job a thousand miles and more. See your Texaco Man today, and say: *"Marfak,* please!"

TEXACO

THE TEXAS COMPANY

TEXACO DEALERS IN ALL 48 STATES

Tune In: { TEXACO STAR THEATRE presents the Eddie Bracken show every Sunday night.
METROPOLITAN OPERA broadcasts every Saturday afternoon. See newspapers for time and stations.

TYPICAL EXAMPLE: THE B. F. GOODRICH TIRE THAT OUTWEARS PREWAR TIRES

SAFETY PATROLMAN OLSON, of the Everett, Wash., Police Dept., appears above, pointing to a B. F. Goodrich tire that has traveled 33,527 miles. He writes:

"Two years ago we started using the B. F. Goodrich Silvertown on our police cars. These tires have been subjected to all types of driving and road conditions, at high speed and in both wet and dry weather. From the standpoint of blow-out protection, the safety of these tires is unsurpassed.

'The tread design is the finest we have ever used—giving skid protection, easy steering and long mileage. We are getting more mileage from this new tire than we got from any prewar tire. These tires are without doubt the finest automobile tires on the road today . . . *will outwear prewar tires.*"

Each week we receive letters such as this. They are written by owners and operators of police cars, passenger cars, taxis. They show clearly that the new B. F. Goodrich tires outwear prewar tires.

In spite of greatly increased production, demand for tires is even greater. Please check your needs well in advance. Talk to your B. F. Goodrich dealer. He'll do his best to keep you rolling until he can get new tires for you. *The B. F. Goodrich Company, Akron, Ohio.*

B.F.Goodrich

FIRST IN RUBBER

Frank Vestal with bass caught on Hawaiian Wigglers in Arkansas

"Typical Hawaiian Wiggler Catch"

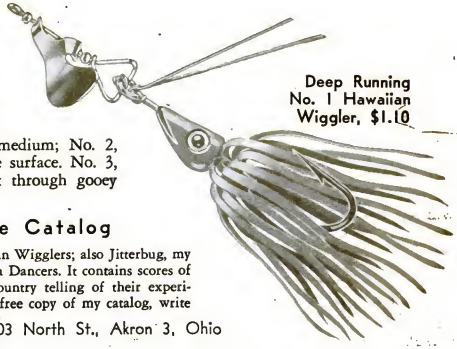
—writes Frank Vestal, Memphis Newspaperman

Dear Fred:

"This creel limit of Kentucky bass caught from Cache River, Arkansas, is typical of Hawaiian Wiggler achievements in the Mid South. Frankly, most of the bass I have caught in the past year have been caught with either the No. 1 or No. 2 Hawaiian Wiggler. My friends swear by these famous baits that are effective both in still lake water or that running in nearby streams."—*Frank Vestal, Memphis Commercial Appeal outdoors writer.*

Hawaiian Wiggler Family

All five members of the Hawaiian Wiggler family are specialized bass baits. No. 1 runs deep and is for rocky streams, lakes and dams. No. 1½ runs medium; No. 2, shallow. No. 2½ sputters on the surface. No. 3, the most weedless, wiggles right through gooey weeds and moss.



Deep Running No. 1 Hawaiian Wiggler, $1.10

Write for Free Catalog

Gives all information on Hawaiian Wigglers; also Jitterbug, my famous surface bait, and my new Hula Dancers. It contains scores of letters from fishermen all over the country telling of their experiences with these popular baits. For a free copy of my catalog, write

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Popular Mechanics Magazine

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Coming Next Month

The story of a house that anyone can build—planned by Popular Mechanics Magazine and built by a young veteran for his bride. Don't miss the Popular Mechanics Build-It-Yourself House, which will be featured in full color in the April issue.

OUR color feature this month which starts on page 105 takes you behind the scenes at the Ice Follies. This was sort of a "cross-country" feature for us. The first photos were made in San Francisco and the last when the show was in New York. Biggest thrill for the cameramen was the timing of Harris Legg in his leap through the flaming "eggbeater."

WHEN you read "Death Valley Patrol" in the April issue we urge you to have a fan handy. This is the story of how rangers protect summer motorists exploring this 140-mile inferno. Another April feature, "The Smartest Ship Afloat," introduces a floating laboratory which tests electronic devices that may save millions of dollars for river and harbor craft.

EVERY farmer needs tractor horsepower in a small package for odd jobs. You'll meet "Farmette" in the Craftsman section next month with detailed how-to-make-it instructions. The tractor is a tricycle type with 7-hp. air-cooled engine, four-speed transmission, variable tread for cultivating narrow rows and a power take-off for driving a mower or similar machine. Other features next month will tell you how to clean the car radiator and how to care for a reflex-type camera.

BEGINNERS will find an unusual one-tube low-cost "progressive" receiver in the Radio section in April—also a converter for the new FM broadcast band.

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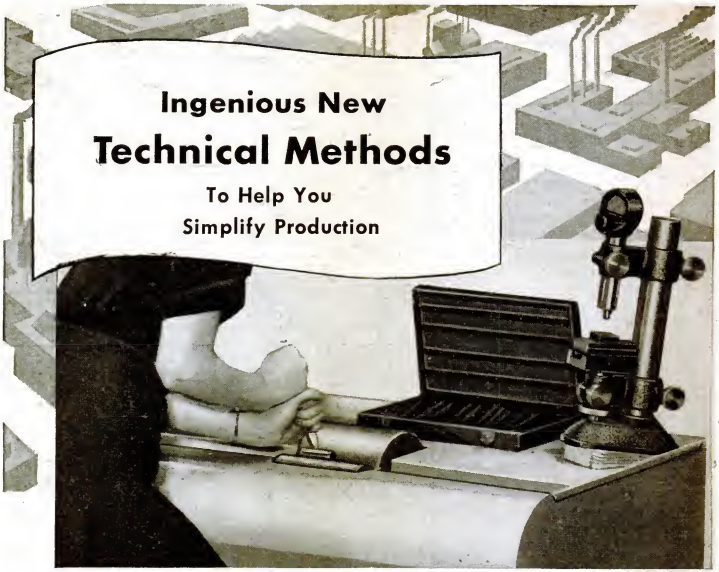
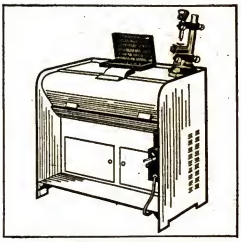


New Centerless Lapping Machine Gives Precision of Less Than 2 Micro-Inches!

Now it's easy to lap cylindrical pieces—quickly—accurately—without specialized operator skill! The new Size Control Centerless Lapping Machine handles pieces from .010″ to 10″ diameter without costly set-ups.

The operator merely holds piece between lapping rolls with stick. Pressure applied determines quantity of metal removed. Small roll turns piece at slow constant rate. Large roll turns more rapidly to remove minute quantities of metal. Ideal for lapping oversize gages, worn gage plugs to next smaller size, bearings, bushings or shafts. Roll speeds easily changed. Adjustable for tapers.



Centerless Lapping Machine

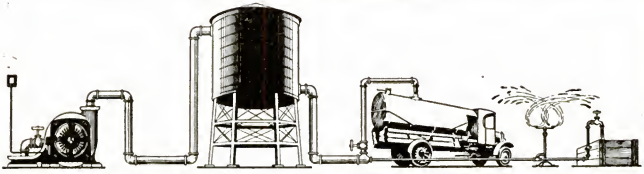
Ideal also to save time on the job, is chewing gum. The act of chewing aids the workers' concentration; seems to make work go easier. Furthermore, chewing gum may be used even when both hands are busy—increasing worker safety—and reducing work interruptions. That is why many plant owners have made Wrigley's Spearmint Gum available to all.

You can get complete information from Size Control Company 2500 Washington Blvd., Chicago 12, Ill.

AB-58

WHY MUST A BATTERY BE RECHARGED?

"Why the Reservoir Runs Dry"

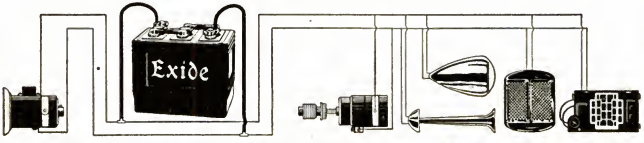


Water Pump
(Operated Intermittently)

WATER RESERVOIR
If you take out more than you put in, the tank will run dry.

Water Outlets

"Why the Battery Runs Down"



Car Generator
(Operated Intermittently)

ELECTRICAL RESERVOIR
If you take out more than you put in, the battery will run down.

Starter

Lights
Horn

Heater

Radio

An automobile battery stores energy, which is constantly being drained by starting, lighting, and supplying current for other purposes. This energy must be restored; otherwise, like water in a tank, it eventually is exhausted.

But, unlike refilling a tank, the battery system on an automobile is automatic. When a car is in average use, the battery is kept at or near full charge; if the car is driven less than the normal minimum, charging is insufficient and the battery "runs down."

See that your battery is kept properly charged.

Check every two weeks to see if water is needed. If water is required more often, the amount of charging is too great; if too little water is required and the hydrometer reading shows below 1.225, the battery is charging too little. Any Exide Dealer will be glad to show you how to get the best service from your battery.

Would you like to know more about batteries? The complete story is told in a booklet, "THE STORAGE BATTERY, Its Fundamentals, Use and Maintenance." Mail a postal card today for a FREE copy.

"WHEN IT'S AN EXIDE YOU START"

Exide
BATTERIES

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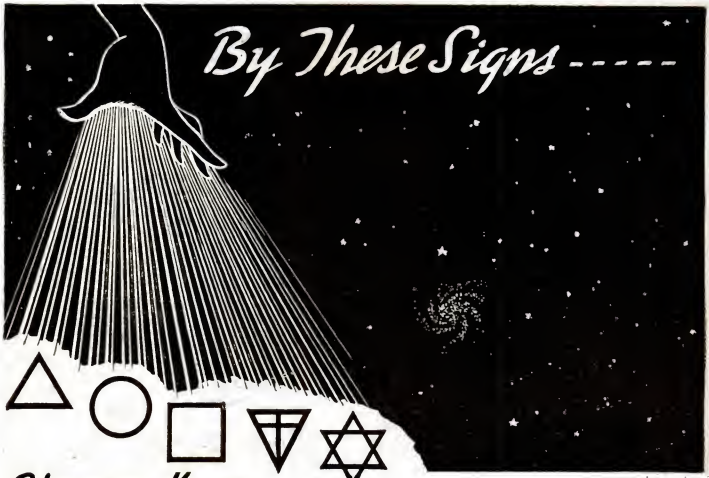

Strange Keys to the Powers of the Universe

"GOD GEOMETRIZES," said an ancient sage. Within the straight line, curve, and angle—and their combinations—exist the forces of creation. These *secret symbols* contain the mysterious laws of the universe. Upon their right use—or the neglect of them—the success or failure of every *human enterprise* depends.

Have you a desire, *something you wish to accomplish* in life? Put your finger on a dot. In whatever direction you move your finger from the dot, you have made a beginning. Thus a dot is the symbol of *one*—or a beginning. Your desire then is also symbolized by *one*. If you follow the *proper method* or way to accomplish what you want, you have arrived at point *two*. Whenever these two symbols are brought together—the idea and the right way—you produce point *three*—the success of your plan. Success, therefore, is symbolized by the three equal sides of a *triangle*.

In planning your personal affairs—business, domestic, or the welfare of your family—do you use a *Cosmic formula?* Do you determine whether your acts are in accord with Divine truths eternally expressed in symbols? Why does the circle represent completion? Why is it said that a man is on the square? These symbols are used by astronomers and scientists to prove the physical laws of the universe—why don't you apply them to the problems of your everyday world? Learn what symbols, as powers and forces of nature, you can simply and intelligently use in directing the course of your life.

Let the Rosicrucians (not a religious organization), a world-wide brotherhood of learning, reveal to you *the symbolism of successful living*.

Let this GIFT BOOK Explain

If you want to prepare yourself through understanding for the greater rewards of life, write for the fascinating *free* Sealed Book. It explains how you may receive this age-old wisdom. Use the coupon below.

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Name.....

Address.....

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THE ROSICRUCIANS, AMORC - SAN JOSE, CALIFORNIA, U.S.A.

If YOU were Boss would YOU promote "YOU"?

Be honest now—

suppose that a better job had opened up in your company—carrying with it promotion and more money—could you qualify?

If you were boss, would you select "YOU" for that better job?

Consider before you answer.

First of all, could you *fill* the job? Has your experience fitted you for the step forward—have you been preparing for promotion apart from experience gained on the job?

Or have you just been filling a niche, doing daily tasks well but making no real and intelligent effort to learn and qualify for the job ahead so that if an opening should occur you would be ready to fill it?

The man who gets real promotion makes his own breaks—the man who slaves in the ordinary job at low pay just wishes and dreams of promotion and more money. Which are you?

Business is always willing to pay the man who knows—and pay him well. The man who is ready and willing to take responsibilities—and capable of directing the efforts of other men is a valuable asset to any business organization. He never wants for a good job and above average earnings. He gets ahead.

We have helped thousands of men achieve promotion and more money—success sometimes beyond their dreams—a success that was started by a coupon similar to the one below.

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So send it today—right now—tomorrow never comes for the man who consistently puts things off.

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If you can help me get the ability and knowledge for real promotion, I want to know it. Please send me your free 48 page booklet telling how I can succeed in the field I have checked below. I understand you will send this without obligation to me.

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Position _____

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City and State ...

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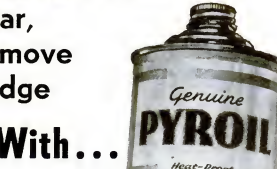
Start easy, Reduce battery drain, Prevent corrosion, Reduce wear, Remove sludge

With...



Pyroil gives oil the added property of clinging to cylinder walls and piston surfaces, protecting them from corrosion and assuring easy, quick lubricated starting. Ask your gas station attendant to add Pyroil . . . every time you buy gasoline or oil.

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Use Aircraft Pyroil B for lubricating oil, Aircraft Pyroil A for gasoline.

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65 Pyroil Bldg., La Crosse, Wisconsin
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Jerry, the talking dog, is entertaining hospitalized veterans, by courtesy of the PYROIL Company. Picture of Jerry, sent on request.

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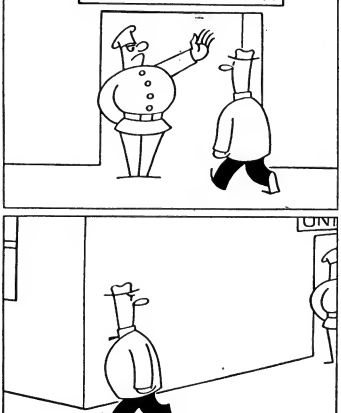

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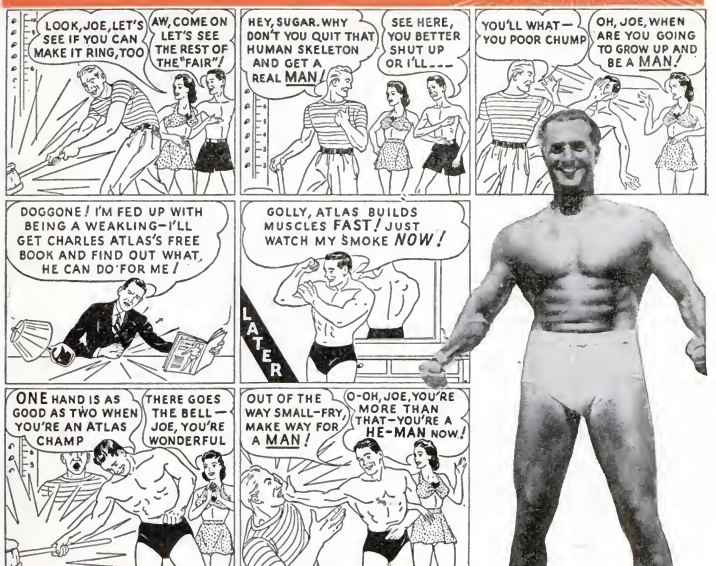

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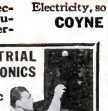

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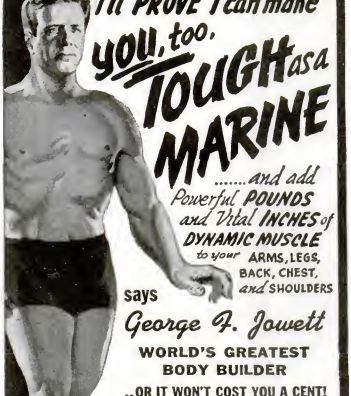

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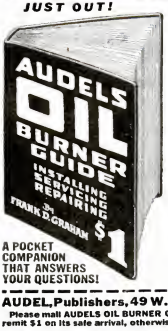

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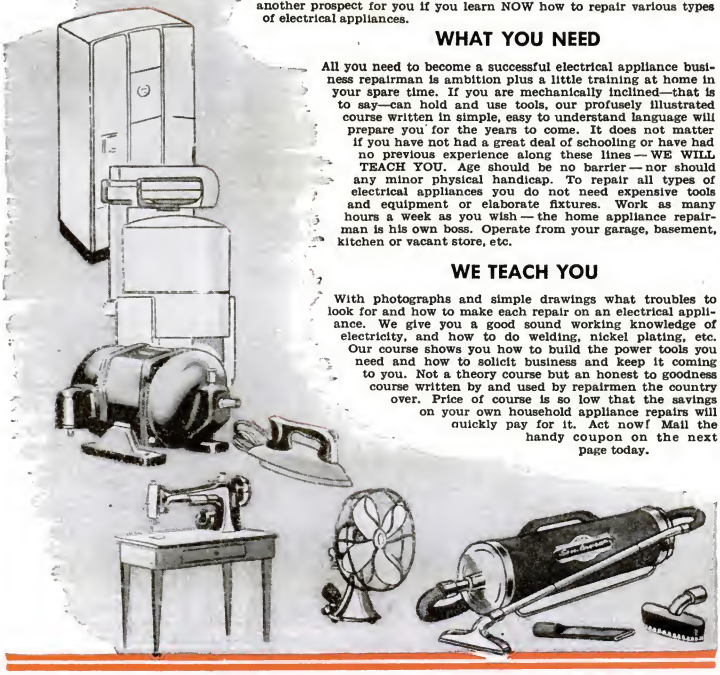

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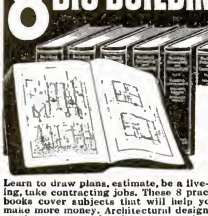

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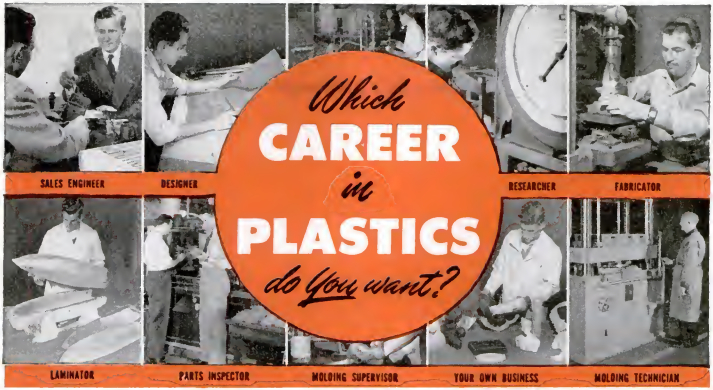

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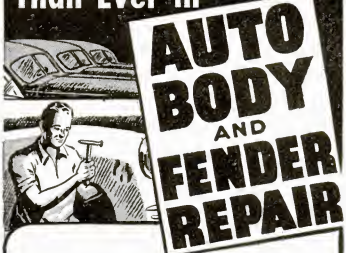

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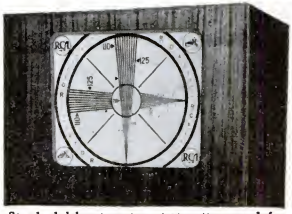

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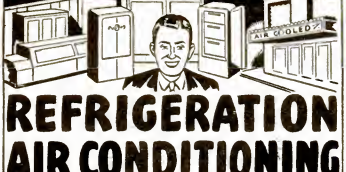

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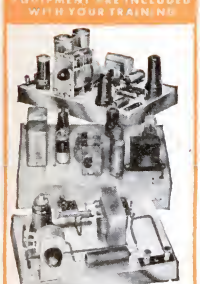

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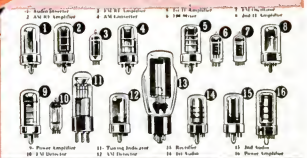

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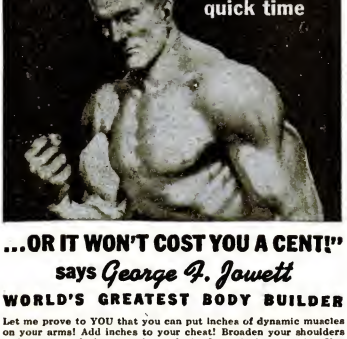

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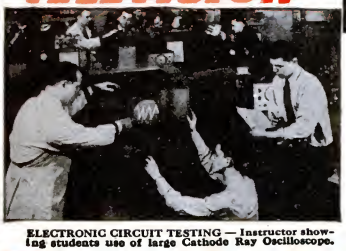

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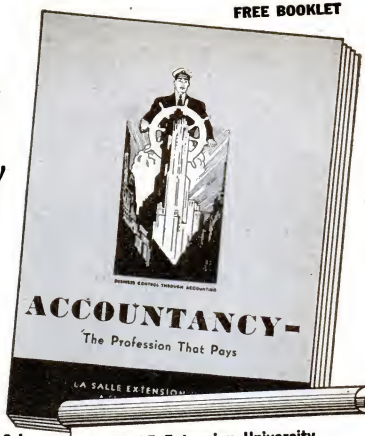

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JET Engines. See Dyna-Jet advertisement under Models classification this issue.

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JET Engines. See Dyna-Jet advertisement under Models classification this issue.

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$46 FROM Square foot plywood. Jigsaw necessary. Write, Woodarts, Bridgewater, Mass.

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FREE Illustrated catalog hard to get fast selling merchandise. American Merchandising, Dept. PMWC-47, 12 Adams, Montgomery, Alabama.

100% PROFIT Or more no investment. Build a profitable steady business, full or part time. Real glossy photo. Amazing stamp size miniatures. Sheet of 100 photo stamps retailed for only $2.00. Write now for free samples and information. American Foto Stamp Co., 103 East 125th St., Dept. (PM1), New York 35, N. Y.

AGENTS Who do woodwork, please write. Curtis' Specialties, Box 1916M, Denver 1, Colorado.

MIRACLE Wax in powder form; home and auto; cleans, polishes and waxes in one application. Miraculous as name implies. One trial convincing. Send 50c for regular $1 can and all particulars. Biess Chemical Company, 4806 North Drake, Chicago, Ill.

MAKE Cleanup selling perfumes, toiletries, over 100% profit. Behm-Charmelle Products, 3635-E Roosevelt, Chicago 24.

EARN Big money. Sunshine everyday cards. Take orders galore from friends for America's most beautiful everyday assortment. 14 folders. Costs 50c. Sells $1. Also 1947 Sunshine notes, birthday, convalescent, everyday gift wraps. Samples on approval. Write today. Sunshine Art Studios, 115 Fulton St., Dept. EE3, New York City.

AREA And State Demonstrating—Distributors Wanted where none are working now. To demonstrate and introduce 2 splendid demonstration products. And to appoint and setup agents and dealers throughout their alloted, exclusive, protected territory. (1) Silver Plating Liquid (NuSilver and Re-Plate-O trademarks) cleans, silverplates and polishes from one application. Either rub-on or dip-in process may be used. Keeps silverware and silvered articles new-looking. Keeps tableware from tarnishing so frequently. Also silverplates onto brass, copper, bronze, zinc, nickel-silver, german-silver, chrome-silver, and some other metal surfaces. Many different uses in every home, office, store, garage, shop, factory, etc. (2) Lectrik Silver Kleaner Atomic Metal Electrode Plates, for de-tarnishing silverware quick (instantly) and fast (as to quantity done). Needed in eating places, lunch-counters, cafes, restaurants, hotels, coffeeshops, roadside stands, etc. Demonstrate it and they want it. Both products sell wholesale and retail, the profits are good, you are in business for yourself, it is a steady business and you can work at it as long as you want to. You ought to have a car if you cover territory, but that is not absolutely necessary (some Distributors work without cars). You should be able to sell, and you should be able to buy your first order to start out with. The cash profits start coming in to you within one hour after you start out. This is a sure-fire good profit business of your own exclusively as long as you work at it. The first item named is a good repeater-seller. You build up a repeat profit business for yourself as you work. Complete details will be sent free by sealed letter-mail if you are located in open territory and if you will write to NuProcess Products Laboratories, Dept. 280, Aurora, Illinois.

AT Last! Something new and sensational in everyday cards. Gorgeous satin and velour designs never before offered. Get orders fast. Big profits. 14 assortments for year 'round occasions retail 60c to $1. Get samples on approval. Puro Co., 2801 Locust, Dept. 740-C, St. Louis 3, Mo.

AT Home—Your own manufacturing business; making popular $1.00 novelties. Cost you 3c to 15c. Everything supplied. Write So-Lo Works, Dept. R-600, Loveland, Ohio.

FREE—Mexican novelty curiosities. Fast seller. Exceptional profits. "Productos," Apartado Postal 9318, Mexico City.

WONDER Silver Plating Liquid. (Silverplates metals without tanks or electricity.) Applied with cloth or by dipping. New, improved, concentrated, double-strength formula; plates larger surface with heavier coating. Good carded item for stores. Wonderful demonstration. Big profits. Free details! Wonder Products, 1265-D Broadway, New York 1, N. Y.

AGENTS Wanted—full or part time—taking orders for household specialties. For particulars write Steinbraker, 1910 Newport, Chicago 13.

GREETING Card agents, "line up" with "Pines" for bigger, better, quicker profits. Rush name, address on postcard today. Box 32, Flushing 5, New York.

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REMNANTS — Amazing values, housewives buy on sight. Good profit. Write B & M Textiles, 415 East 26th St., Paterson 4, N. J.

LAWN Mowers — gas-electric. Factory franchise. Write quick. Rotacut, M-2003, Excelsior Springs, Mo.

FIREWORKS, Cap guns, caps, balloons, tops, etc. Fast selling items. Send for catalog at once. Wentworth Sales, Inc., 117 North Wabash Ave., Chicago 2, Ill.

"27" AGENTS,—Salesmen Wanted! Liberal territory alloted. Demonstrate amazing "27 Second" eye glass cleaner. Whirlwind seller. Year's supply in compact only 59c. 2 for $1.00. $40.00 per gross—110% profit. 27 Second Cleaner Co., Dept. 192, 6337 N. Talman, Chicago 45.

90c PROFIT Each $1 sale. Sell positive mothproofing solution to housewives, stores, agents. Experience unnecessary. Postal brings details. Kinford, Wayne 3, Penna.

AGENTS. Substantial profits. Repeat order products. Not mere "job" but opportunity establish steady income. Additive lubricant. Limitless field. Factories, autoists, service stations, fleet owners buy in huge quantities. Write Kidder Oil Company, LaCrosse 1, Wis.

MEXICAN Feather pictures. Unusual novelty. $1.00 (stamps) bring $2.00 worth samples, details. Refunded if unsatisfied. Aztec Art-P, Apartado 762, Mexico City.

AGENTS: Stamping names on pocket-key protectors. Sample check with your name, address, 25c. Stamping outfits. Emblem checks, check-fobs, name plates. Hart Mfg. Co., 303 Degraw St., Brooklyn, N. Y.

SELL New-Used clothing from home, auto, store. Men's suits $1.17. Leather jackets 85c. Overcoats 62c. Dresses 17c. Ladies' coats 38c. Other bargains. Catalog free. S & N, 565A Roosevelt, Chicago.

137 COMPLETE Plans for starting own business: local—mail order. Particulars free. Elite Co., 220 Grand St., New York 13.

COLLEGE Students! 100% profits selling costume jewelry. Wm. Morris, Maywood, New Jersey.

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AGENTS—Big line including food products. Fast selling premium and bargain deals. Low prices. Send card for big profit offer with gift. Ho-Ro-Co, 2796 Dodier, St. Louis 7, Mo.

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AGENTS—300 % Profit selling genuine gold window letters; stores and offices. Free samples. Metallic Letter Co., 438-B North Clark, Chicago.

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SCHOOL Seniors! Your postal will bring our wonder, Kwick-Sell Cardalog of popular graduation name cards. Biggest profits! Only firm giving free souvenir chest and card case. Don't miss out! Hurry that postal! Craftcards, Box 235(L), Pittsburgh 30, Pennsylvania.

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SELL Year's supply cartoon ads to filling stations for $52! Complete sales kit with mats; send $15. Apollo Advertising Agency, Gainesville, Texas.

SALESMEN Wanted to sell 6c quality cigars. Commission basis. T. Miller & Son, Est. 1898, 874 Broadway, New York.

STATE Distributors to sell simplified bookkeeping system small stores and public accountants. Sells $13.50, your commission $8.00. Exclusive franchise. Write Hawthorne Sales Co., Decatur, Ala.

SALESMEN: Carded saccharin for quick sales. Complete price list free. Consumers Products, Tiffin, Ohio.

DEMONSTRATE, Sell to taverns, amazing, original glass rinse "Clear Glass." No toweling, no water spots. Guaranteed. Sample 25c. Riesen Chemical, 419 Vliet, Milwaukee 12.

JOBBERS Sell sensational spring metal clothes pins, 39c dozen, cost $2.30 gross. Also aluminum laundry tub shelf $1.00; fits standard tub. Your cost 50c. Clothes line set with pulleys and tightener $2.00. Your cost $1.00. Immediate shipment. Thomas Products Company, Detroit 21, Michigan.

$70.00 WEEKLY Selling twenty boxes greeting cards daily. Eighteen money makers. One earned $160.00 weekly. Samples on approval. Details, Carleton Distributors, 25 W. 17, Bayonne, N. J.

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START Your own business on our capital. Always your own boss. Hundreds average $6,000 to $25,000 annual sales. We supply stocks, equipment on credit. 200 home necessities. Selling experience unnecessary to start. Wonderful opportunity to own pleasant, profitable business backed by world-wide industry. Write Rawleigh's, Dept. C-U-PPM, Freeport, Ill.

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WAGON Salesman—Fast moving carded goods and 10c line. Long profit. Free facts. Peerless, 2717 Dodier, St. Louis 7, Mo.

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BIG Money rebuilding shoes. Help needed everywhere or start big-income business of your own. Learn practical, sure, easy way in 3 months. Anyone from 18-60 years can learn easily. Approved for GI training. Rush postcard today. Modern Shoe Rebuilding School. Est. 1927, 2935 Belmont, Chicago 18, Illinois.

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INCH Display advertisement Mailorder World, year $24. Wood's Popular Services, Atlantic City, New Jersey.

ADVERTISERS: Mail order ad covering United States—2,000,000 circulation—$21.00 inch. Classified ad, 24 words, 20 metropolitan Sunday newspapers—$25. Magazine, newspaper, mail-list ratebook, adwriting assistance — free. Chicago Advertising Agency, 20-PM West Jackson, Chicago 4.

ADVERTISE: 24 Words, 40 newspapers $3.50. Lists free. Advertising Bureau, 4515-C Cottage Grove, Chicago 15.

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DELUXE Two color gummed labels, about ⅞x1¼", with name and address, 3 lines. 500 for $1 or 1000 for $1.50. Mutual Sales, 751 Jenifer St., Madison 3, Wis.

THOUSAND #10 Envelopes $6.95; 500—$4.25. Thousand 6¾ or 6¼ envelopes $4.25; 500—$2.75. Williams Sales Company, Box 4100, Portland 8, Oregon.

2¼x3¼ GUMMED Labels; 500—$1.75; 40 word limit. Schultheis, Box 449, Irwin, Penna.

250 LETTERHEADS $1.50. Envelopes same. Mallo, 767 Leith, Flint 5, Mich.

1000 6¾ ENVELOPES $3.95. Harry Boynton, 1909 Glade Road, Columbus, Georgia.

125 6¾ ENVELOPES $1.00. Get sample. P.O. Box 356, Nazareth, Penna.

75 HAMMERMILL Letterheads and 75 envelopes $1.00 postpaid. Benneville Printing, Box 1931, Pittsburgh 30, Penna.

PHOTO Offset, printing, multigraphing. Samples free. Mango, 555-A South 20th, Newark 3, N. J.

100 BOND Sheets 8½x5½; 100 bond envelopes, 6¾. Printed $1.25. Biggs Press, Lewis, Indiana.

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OUR Customers say — "You do good work." Send copy for free estimate and sample of package inserts, cards, labels, stationery, etc. S. & M. Press, 3206 Eastwood Ave., Chicago 25, Ill.

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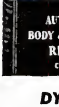

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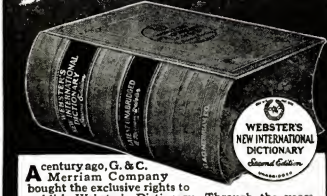

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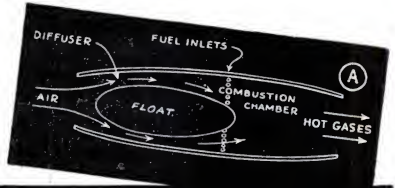

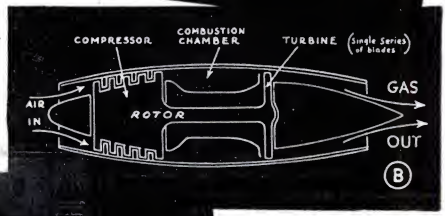

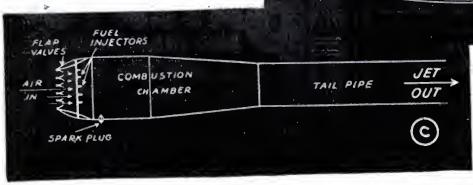

A. RAMJET

B. TURBOJET

C. INTERMITTENT JET

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Q. *What makes a Jet plane go?*

A. Compression of a gas to a high pressure in a confined chamber, and conversion into a high-velocity gas stream expelled into the air.

Q. *Are all Jet devices the same?*

A. No. The three types used on aircraft are the Ramjet, Turbojet and Intermittent Jet.

Q. *Can any of these drive a plane out of the earth's atmosphere?*

A. No. All three need oxygen from the air. Rockets, which carry their own oxygen, are the only known source of power for interplanetary travel. The Army Air Forces is experimenting with rockets, too.

Q. *Can any of these start from a standstill under its own power?*

A. Only the Turbojet. Its compressor acts as a starting motor, sucking air for combustion. The other types depend upon forward motion for intake of the necessary air.

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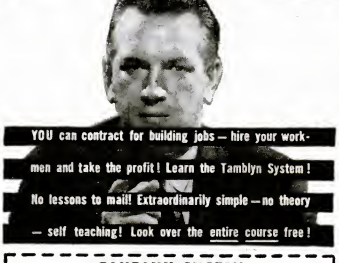

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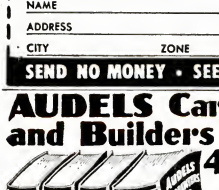

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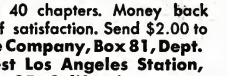

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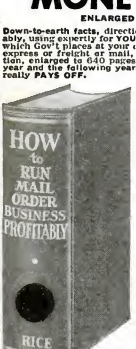

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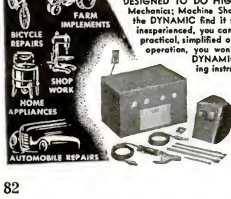

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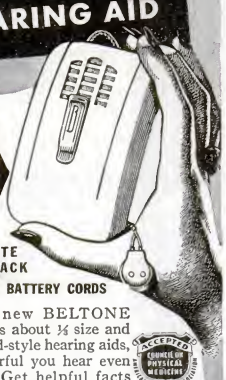

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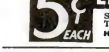

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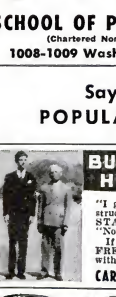

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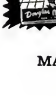

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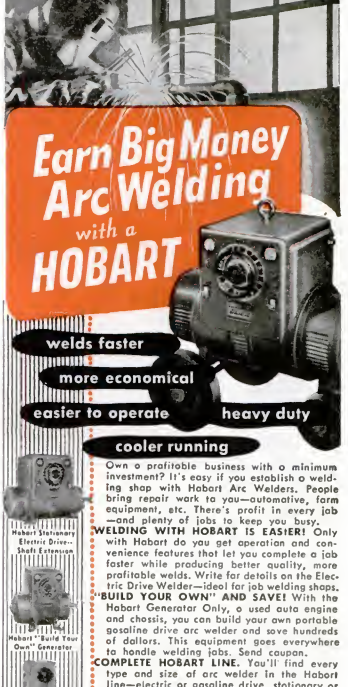

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POPULAR MECHANICS MARCH 1947
WRITTEN SO YOU CAN UNDERSTAND IT
VOL. 87 NO. 3

Proving Ground for Gasoline

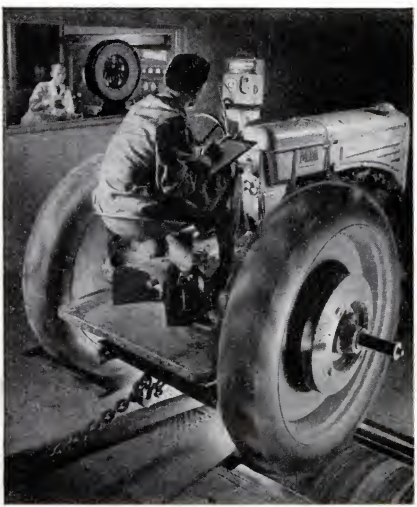
By Wayne Whittaker

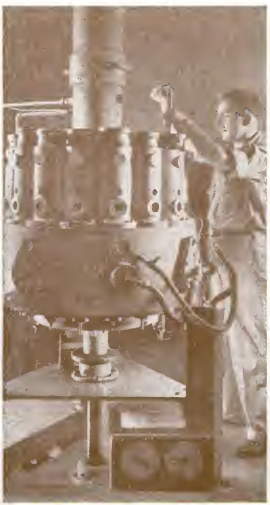
IF YOU burned 600 gallons of gasoline in the family jalopy last year, the chances are you will be buying only 480 gallons in 1950 for the same mileage. That's a saving of 20 percent, a respectable figure on anybody's budget. It also means that 5,000,000 additional American automobiles may be operated 40,000,000,000 miles without using any more gasoline than was burned in 1946!

These figures are not somebody's pipe dream or something pulled out of a hat to startle the public. They are "well within the realm of possibility," according to Earl Bartholomew, general manager of the new Ethyl Corporation Research Laboratories in Detroit. His conservative predictions are based on research he has conducted by rolling up his sleeves and working alongside the men in his vast laboratory.

This laboratory is filled with some of the most intricate research equipment ever devised by man. Electronic recording devices perform superhuman stunts that amaze the layman. The prime function of the lab is to take the hit-or-miss out of both engine and fuel research by combining the two under one roof.

The engineers reasonably point out that the development of a super gasoline is futile without the proper engine in which to burn it; also that increasing the compression ratio of an engine and introducing other refinements is just so much wasted effort unless the proper fuel is available. Visitors to the labs are greeted with this sign: The





Tractor rides chassis rolls for fuel test in room with temperature range from 50 below zero to 150 above Right, corrosion furnace is the only one of its kind and tests metals under heat and stress for jet planes

Fuel "switchboard" routes various blends to engines

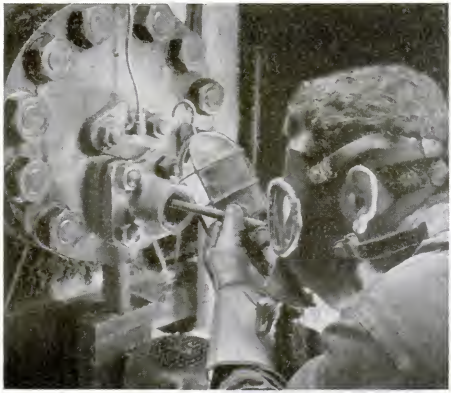
Gauge shows wear to nearest 0.0001 inch in cylinders

Problems of Engines, Fuels and Lubricants Are Inseparable. Automobile drivers became acutely conscious of this fact when low-grade gasoline knocked and pounded in their engines during the war.

The Ethyl Research Laboratories were virtually a wartime secret and only recently made their bow to the public. Construction of the laboratories was almost finished at the time of Pearl Harbor and the project was rushed to completion. Then the Army, Navy and Air Forces promptly swamped the place with demands that taxed resources to the limit.

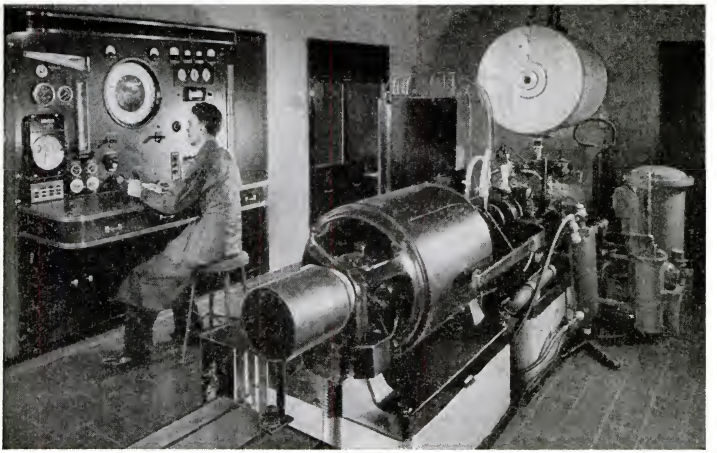
"It seemed as if this place had more guards than the White House," said one engineer, "and we had our share of red tape, too. Still, we managed to find some right answers."

Engineer readies autoclave in small pilot plant for making tetraethyl lead



These "right answers" were concerned with tanks roaring into battle in desert heat and grit; lifting bombers into the substratosphere and boosting the speeds of fighter planes; the starting of trucks in subzero Aleutian weather, and the propelling of landing craft onto tropic beaches. The military demanded more and more horsepower, greater and greater dependability, and better fuels of the highest antiknock quality possible.

All of this, of course, is in the past, but it will always be an important chapter in the more than



Dials reveal knock rating, air-fuel ratios and other vital data; the dynamometer rests on a concrete block

20 years of Ethyl research. Now there is a turnabout in lab activity and the projects are devoted to fuels and engines for peacetime use. However, much that was learned during the war will have a profound effect on future engines and fuels.

One of the first things that impresses a visitor to the lab—aside from the spotless and attractive layout of the plant and its general efficiency—is the possessive air of the engineers, chemists and other research experts. This is explained by the fact that the research workers themselves took an active part in planning the layout. Practical suggestions ranged all the way from the positioning of a dynamometer control panel to placing double doors between laboratory rooms and adjacent offices to reduce noise.

The laboratories are built in the shape of the letter E with the two-story back of the E fronting to the south on a suburban highway. Three one-story wings extend north to form the legs of the E.

Let's open a few of those double doors for a close look at some of the activities that may help save us one gallon of gas for every five in 1950.

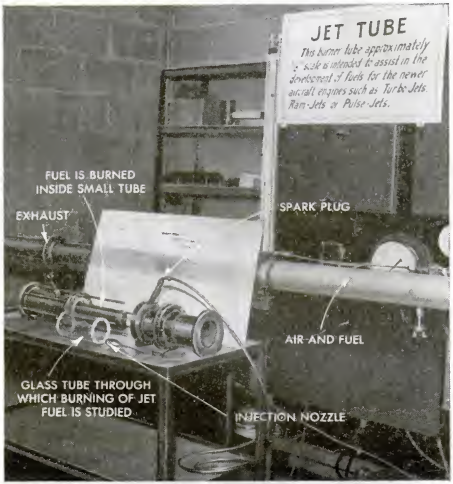
In the instrument section in the main wing, Emil Gillig, the section head, is busy completing construction on a new test stand for calibrating electronically operated spark advance and tachometer indicators.

"Most of the instruments you see here," he explained, "are the only ones of their kind, for we had to design and build them to do special jobs. Our great problem in the labs is to duplicate actual road operation and to build instruments that will record accurately what happens in investigations both in the laboratory and on the road."

One instance was cited where a valve material seemed perfect under a constant speed and throttle opening test in the lab,

Atomic model in library aids study of fuel makeup

Preparing cars for road tests with an anemometer (foreground) to measure wind velocity, a spark advance meter (being lifted into car) and a "fifth wheel" speed indicator. Below, window in burner tube aids jet fuel research



but later failed in engines undergoing the wide variety of speed and load changes encountered in actual road operation. Such flaws show up under simulated road conditions with electronic recorders taking the "pulse" of the engine. One electronic self-balancing strip-chart recorder prints at two-second intervals a continuous record of temperatures measured at 12 points on an engine.

One of the most ingenious instruments is a pneumatically operated "piano player" machine that plays not a tune but an actual road trip on an electric dynamometer and engine. First a perforated tape about six inches wide is prepared from a log of speeds and manifold vacuums obtained during actual operation of a vehicle on the road. This tape travels across a tracker bar having 25 holes connected to bellows which operate switches providing 20 engine speeds and 31 different throttle settings. Listening to an engine which is controlled by this apparatus, particularly of a recording made in traffic, gives the illusion of a sound track for a movie scene in a car.

The infinite care with which research is conducted is evidenced by a gauge used to determine wear on cylinders. This gauge and a master reference ring are used at the start and end of an endurance test to reveal wear to the nearest 0.0001 inch at as many as 42 locations in each cylinder.

Also on the ground floor of the main wing is the single-cylinder engine section. Here one experimental fuel mixture after another is run. C. L. Davidson, head of this section, explained that there are thousands of potential fuel blends and only

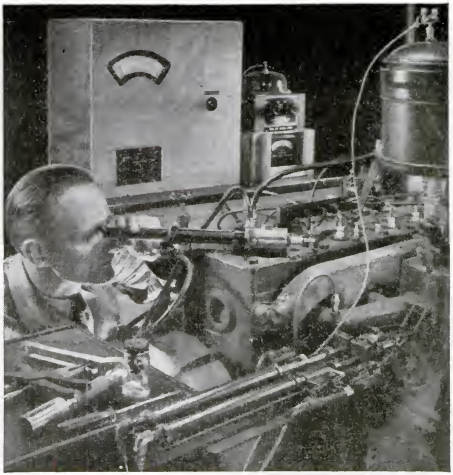
by systematic studies of the different classes can the most satisfactory combinations be determined. Using normal heptane and iso-octane as bases he prepared several samples of 70, 80 and 90-octane fuels. During research on auto ignition every abnormal combustion in certain engines is counted and recorded electronically. The counter, Davidson says, is far more accurate than the human ear and has made a tedious job almost entirely automatic. Special fuels in such small quantities as only 50 or 100 cubic centimeters can be switched in for a test of 30 or 40 seconds.

In one special engine for comparisons of gasolines, two separate fuel systems are used. The fuels are weighed and pumped into the air stream. One fuel is run with the engine set at a certain compression ratio and the spark is advanced until a knock is registered on a knockmeter. An identical test for the second fuel may show no knock at an even greater spark advance —evidence of a better fuel under specified engine conditions. Chemical antiknock agents were discovered by the late Thomas Midgley, Jr., former vice-president of the Ethyl Corporation. Tetraethyl lead, the principal one of these, is added to most automobile gasolines, and it is also an essential ingredient of all high octane aviation gasolines.

There are 17 engine dynamometers in the laboratories, ranging in capacity from 7½ to 450 horsepower. The engines are moved about by traveling cranes. Fourteen of the dynamometers have engines mounted at either end so one engine can be in operation while work is being done on another.

Two chassis dynamometers are installed in "hot" and "cold" rooms for high and low temperature studies. Load limit on the chassis rolls, which are placed slightly below floor level, is five tons. In case of a blowout of a rear tire on an automobile or truck during operation on the rolls, the differential drops down on a block which prevents a vehicle from swinging off the rolls. A blower facing the car can create a blast of air up to 100 miles an hour. The air speed may be automatically controlled by rear-wheel roll speed. This control, together with additional automatic equipment to

(Continued to page 280)



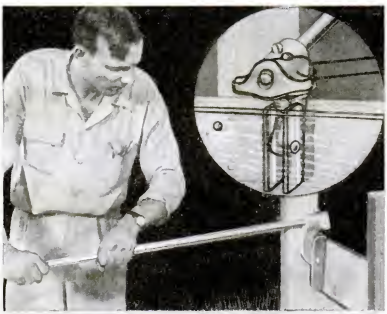
Spark plug viewer shows what goes on in area immediately surrounding gap

Engineer takes readings from electronic spark advance meter on the road

Callers "Checked" Undetected Through Mirror-Window

While the peddler sees only his own reflection in the mirror-window, housewife's view of him is shown in inset. Right, loading chrome alloy in a tungsten filament for surfacing glass in a hot evaporation chamber

Now you can give callers the once-over undetected through glass that is a mirror from the outside, a window from within. Ordinary mirrors are silvered chemically by hand on the back surface, then covered with an opaque backing to prevent tarnishing or rubbing off. The new transparent mirrors are surfaced by "molecular bombardment" with chrome alloy, which forms a film four ten-millionths of an inch thick. While providing an effective reflective surface that won't rub off or tarnish, the film permits sufficient light passage so that clear photographs can be made through it. It is also expected to be used as a door panel between kitchens and dining rooms, for observation screens in child behavior clinics, psychiatric wards and hospital operating rooms, in glazing shower stalls and as a "security" window in banks. The process employed is based upon an invention of Dr. John Strong of Johns Hopkins University.

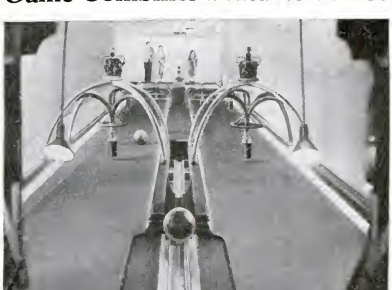


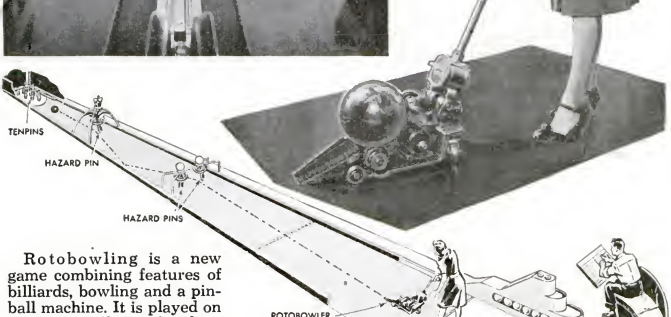
Prying Tool Stops Splitting To Boost Lumber Salvage

Reclamation of usable lumber in razing jobs is made easier by a prying tool said to prevent splitting. When placed against the board to be removed, the tool hugs adjacent studding and its extended steel lips support the leverage pressure applied to the handle. The tool lifts and loosens ordinary planking, tongue and groove flooring and shiplapped siding.

¶Birds in the Bikini area were unharmed by the two atomic bomb bursts and recent surveys showed no noticeable change in numbers.

Game Combines Features of Both Bowling and Billiards





Rotobowling is a new game combining features of billiards, bowling and a pinball machine. It is played on a carpeted alley 94 feet long and 4 feet 4 inches wide, with rubber cushioned sides instead of gutters. At the far end are ten pins, slightly larger but similar in shape and alignment to those used in bowling. Suspended over the alley or court at two intervals are hazard pins, which cause lights to flash when struck. The ball, an inch-thick aluminum shell nine inches in diameter and weighing 18 pounds, is propelled by the player from an electric machine resembling a vacuum cleaner. It delivers the ball at any speed up to 4500 revolutions a minute. The object is to knock down the most pins while banking the ball the greatest number of times against the sides or hazard pins. The game is scored by multiplying pins downed by banks made, with 600 points as a perfect game. For example, four banks times eight pins equals 32 points. A game is six plays, with two balls to each play, and each delivery is scored separately, rather than by bowling's strike-and-spare system.

Metal Strip Smaller Than Common Pin Tunes in Radio Broadcasts

With a strip of metal smaller than a common pin for a receiver, scientists at Johns Hopkins University in Baltimore are tuning in radio broadcasts. The scientific freak was discovered during experiments with a bolometer, a device developed during the war for "seeing" in the dark with infrared rays. A threadlike ribbon of columbium nitride is the "receiver" of the bolometer. It picks up broadcasts when cooled to a temperature of 435 degrees below zero Fahrenheit. Tests with the bolometer are continuing although its sensitive qualities offer no revolutionary radio development.

"Eye" for Ground Forces Flies as Low as 50 M.P.H.

Designed to spot and direct artillery fire, the Boeing L-15A flies under 50 miles an hour and has a transparent gondola that affords exceptional visibility in all directions. Another distinguishing feature is its reversed tail surfaces. The two-place craft takes off and clears 50-foot obstacles in 600 feet and lands under similar conditions in 517 feet. It can be towed in the air as a glider and freed to fly after its engine has been started. The gondola's large-size rear door is completely transparent and the observer's seat can be faced either forward or backward. At normal cruising speed of 100 miles an hour and with an extra fuel tank, the plane can fly 5½ hours. The wing span is 40 feet, length 26 feet 1 inch, gross weight 2050 pounds and the service ceiling 16,400 feet. The entire airplane can be quickly taken apart and loaded on a standard 2½-ton Army truck. The L-15A is also adapted to courier and photographic work.

Guide for Painting Frames Protects Window Glass

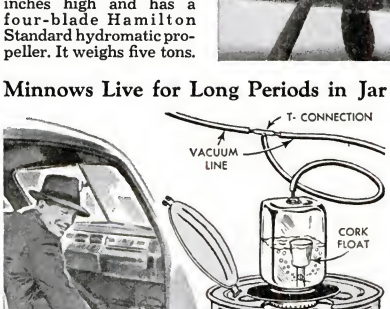
Painting the frames of windows and screens is simplified by a guide held against the glass or screen and adjacent to the frame to catch excess paint. The guide has a thin, curved metal blade 10 inches long and two inches wide with a duralumin handle in the center. One end is shaped like a knife blade to reach into corners and other obscure places.

¶Ultraviolet rays from flames actuate a new sensitive fire alarm device developed by the Navy.

U. S. Navy's First Plane With Turbine-Driven Propeller

First Navy plane with a turbine-driven propeller is the bullet-nosed Ryan XF2R-1 fighter, adaptable to either land or carrier use. Nicknamed the Dark Shark, it is believed to be in the 500-mile-an-hour class, although performance figures have not yet been revealed. It has two General Electric engines, a turbine in the nose and a turbojet in the tail that provides thrust on take-offs and whenever extra speed is needed. The propjet unit in front, using about three quarters of its power for the propeller and the rest for exhaust, operates alone for cruising. The Shark is 36 feet long, about four feet longer than an earlier Ryan model combining piston engine and turbojet. The added length came from substituting a long, narrow jet unit for the short, stocky engine. The XF2R-1 has a 40-foot wing span, is 13 feet 11 inches high and has a four-blade Hamilton Standard hydromatic propeller. It weighs five tons.

Minnows Live for Long Periods in Jar With Vacuum Attachment



Live minnows in standard bait buckets can be transported long distances in an automobile with a glass jar and valve attachment that agitates and aerates the water. The attachment connects by rubber hose with the vacuum line beneath the automobile dashboard and draws fresh air into the jar through a system of intakes and outlets. The air forces the water to circulate, providing a constant flow of "fresh" water.

You may wish to obtain additional information about the new products described each month in Popular Mechanics. If you want to know the name of the manufacturer or distributor, just write to Bureau of Information, Popular Mechanics, 200 E. Ontario St., Chicago 11.

LABORATORY IN SPACE

Part Two

One of the three Superforts being used at Inyokern for very high altitude cosmic ray photography missions

HIGH-CLIMBING V-2s are measuring the quantities of cosmic rays in the upper air but these samplings tell very little about the nature of the rays. For more thorough study the scientists are using B-29 bombers that have been converted into flying laboratories.

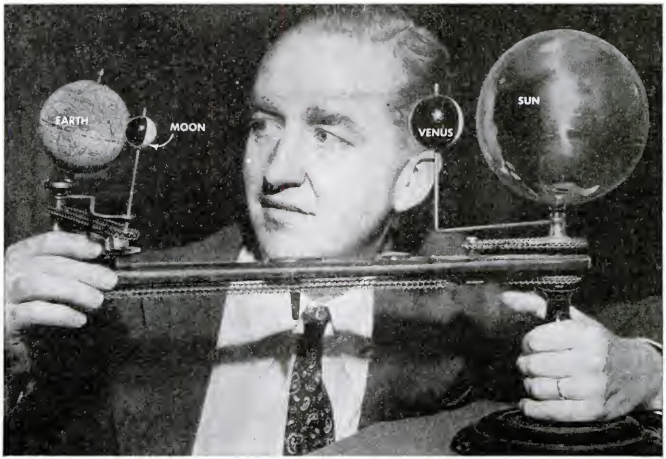
Dr. Carl D. Anderson of California Institute of Technology and Dr. Robert B. Brode of the University of California are heading two research teams that are making stereoscopic and other cloud chamber photographs of cosmic ray phenomena at 40,000 feet. Their B-29s, based at Inyokern Naval Ordnance Test Station in the California desert, carry up to three tons of equipment for making the photographs.

Scientists are seeking the infrequent pictures that show the disintegration of cosmic rays when they collide with other particles of matter. Study of the debris from such collisions is one of the most important tasks in which physicists are engaged. As one explains, "These studies may lead to a better understanding and hence to a better control of nuclear forces."

The collisions are quite rare close to the earth's surface. The B-29s are obtaining some photos of them eight miles up and plans are under way for taking similar pictures 20 miles up. To do this the Army and the National Geographic Society expect to build a passenger balloon capable of rising to 100,000 feet this year. Carrying a stratochamber in which two men would work, the balloon actually will consist of several separate balloons attached to the stratochamber. Various upper air studies as well as primary cosmic ray photography will be undertaken.

Some instruments designed for the balloon are being tested at medium

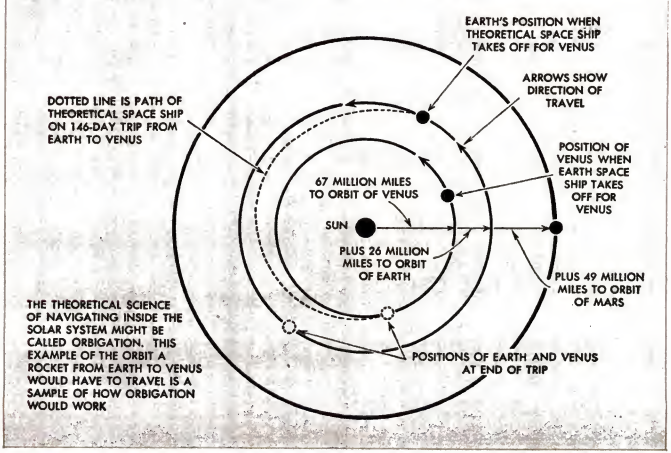
Dr. Robert Brode checks 12-inch cloud chamber for studying cosmic rays in the B-29 laboratory

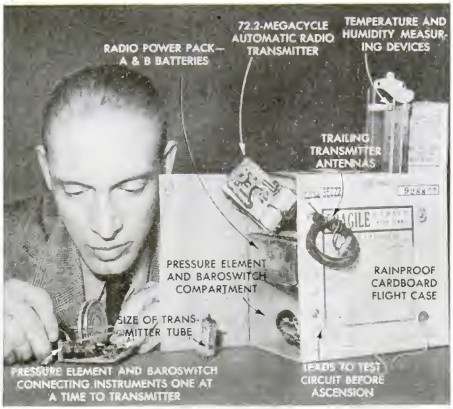


Device used by Dr. Samuel Herrick in rocket navigation classes to trace motions of earth, moon and Venus

TABLE OF VELOCITIES FOR ROCKETS (theoretical distances achieved)

1-mile-per-second take-off (V-2) . .	80-mile-plus climb . .	Suitable for point-to-point on earth
4-m.p.s. take-off	2000-mile climb . . .	Suitable for satellite space island
6.95-m.p.s. take-off	Velocity of escape . .	Suitable for traveling to moon or beyond





Rockets equipped with automatic weather recording instruments and transmitters could short-wave weather data from the moon 240,000 miles away

altitudes at Inyokern. These or similar ones will some day be carried far out beyond the atmosphere's limits by rockets.

The broad pattern of the campaign for the conquest of space has been pretty well outlined and scientists are beginning to take up its tactical details. One of the first steps will be attempts to launch small satellite bodies that will revolve around the earth. This is to to be part of the artificial meteorite project at White Sands.

Much more ambitious and now considered scientifically plausible is the German proposal of a "space island" that would circle the earth at a distance of several thousand miles. Like the moon, the island would revolve around the earth without the use of power. It would be subject to the same physical laws that control the moon; its speed would prevent it from falling back to earth and the earth's gravity would keep it from sailing away into space.

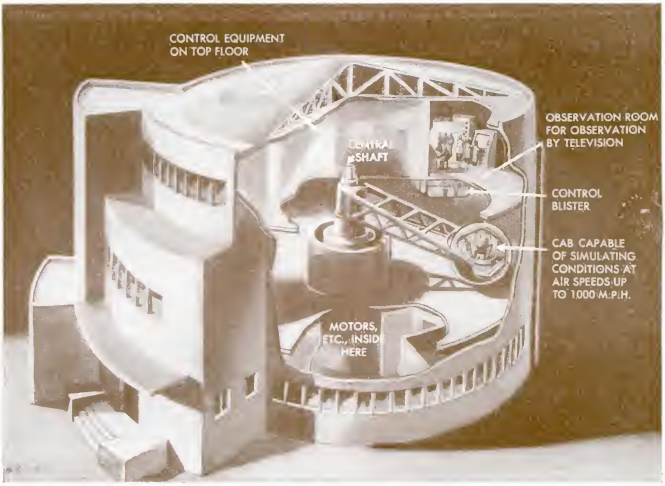
A habitable space island would have to be a hollow shell inside of which a comfortable atmosphere and temperature could be maintained. The shell would need to be strong enough to avoid blowing up in the vacuum of space and it might have to be kept in rotation to equalize the extremes of temperature that would exist. The side of the island exposed to the sun would be blisteringly hot while its shady side probably would have a temperature of several hundred degrees below zero.

This observation post would be ideal for certain astronomical studies, might be important in long-range weather forecasting, and valuable for some kinds of research in physics and chemistry.

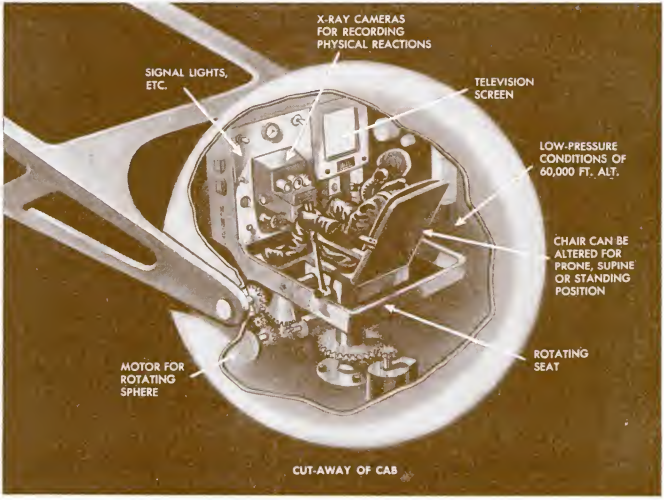
More attention, however, is being given another idea—that of launching rockets at the moon. No rocket yet built can escape from the earth but a two-stage step rocket capable of making the trip probably could be designed today. Carrying instruments, the rocket would automatically radio reports back to earth on conditions on the lunar surface.

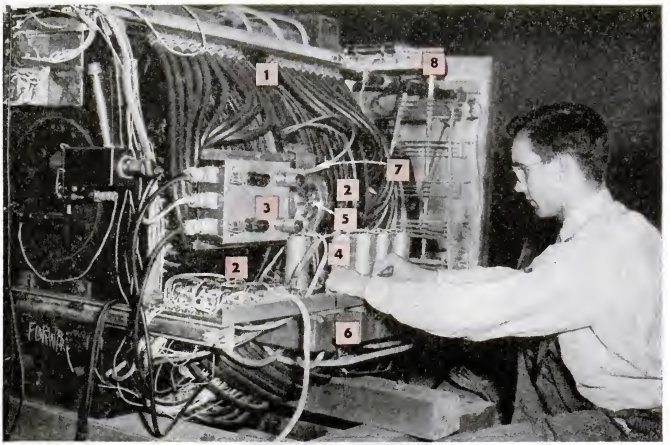
Space ships, of course, are still in the misty future. To escape from the earth

Photos of cosmic rays, showing trails of ionized water vapor particles left behind as they speed through the cloud chamber, are made with stereoscopic camera at left. Dr. Carl Anderson, right, at chamber's control panel



One of the biggest unknowns in the campaign to conquer space is man's reactions to supersonic flight. Tests of this will be made in the giant centrifuge, shown above and below, being built by the U. S. Navy at Johnsville, Pa. The pilot's pressurized cabin will be spun around a central shaft at simulated speeds up to 1000 miles an hour





Exterior of three-ton cloud chamber, carried in B-29 bomb bay for high-altitude cosmic ray studies. Its main parts are: (1) hose carrying cooling water for electromagnet, (2) electromagnet windings, (3) vacuum tubes in Geiger counter circuits, (4) row of Geiger counters, which trip cloud chamber, camera and high-speed flash when actuated by cosmic radiation, (5) inspection lamp, (6) circuit breakers, (7) cloud chamber and 6000-volt flash inside housing, with camera hidden at far left, (8) selenium rectifiers to prevent surges from magnetic field

they would need to be launched at a speed up to seven or eight miles per second, some eight times faster than the top speed of a V-2. No power plant capable of doing this has been developed.

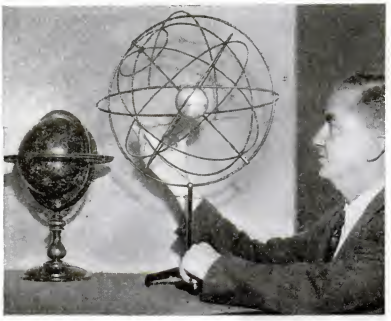
Scientists are pecking away at the problem. They have begun to develop, for instance, the navigational technique that would need to be used for any kind of space travel. Dr. Samuel Herrick of the University of California, Los Angeles, who is conducting classes in rocket navigation, has drawn some surprising conclusions about future space travel.

In the first place, extremely little fuel would be needed, considering the distances involved. Instead, the rocket captain would take advantage of the gravitational attractions of the sun and planets and would be drawn steadily toward his goal. The orbit of Venus is 26,000,000 miles closer to the sun than the earth is and a space ship bound for Venus would become a tiny asteroid. It would follow a curved path around the sun and would be aimed to intercept Venus itself. The quarter of a billion miles total distance would be traveled in some 146 days.

Venus travels faster than the earth and so the space ship would take off while Venus was still far behind. Venus would overtake the earth and pass the space ship, then the ship would catch up with it.

"It probably would be necessary to fire the space ship backwards from the earth, so to speak," Dr.

(Continued to page 284)



Model of celestial coordinates, with earth in its center, used by Dr. Herrick in working out problems of interplanetary navigation

Tail-Pusher Plane Cruises 200 M.P.H.

Both engines and an eight-foot propeller are behind passengers in the Douglas Cloudster, a low-slung five-seater for charter or executive use. Having the cabin ahead of the wings permits greater visibility and entrance through an automobile-type door 15 inches from the ground. Either or both engines drive the two-blade propeller. A design offshoot of the big Mixmaster bomber, the plane cruises 200 miles an hour and has a range of 1100 miles. It has a wing span of 39 feet 9⅜ inches and is 35 feet 4½ inches long. An exceptionally wide spread of over 15 feet between the main landing wheels is intended to give greater ground stability.

'46 Air Safety Mark Doubles '45 Record

In 1946, when 13,000,000 air line passengers traveled 6,000,000,000 miles in the U. S., it was twice as safe to fly as it was in 1945. The Air Transport Association estimates there were 1.2 passenger fatalities per 100,000,000 revenue miles, compared with 2.17 the year before. On international runs, a million passengers covered a billion miles during the year. The number of planes in operation rose to 816, of which 655 were used domestically, and total seating capacity jumped from 10,889, in 1945, to 24,541.

Resistance Tightens Grip Of Plier-Action Wrench

Instantly adaptable to a wide variety of work, a wrench with plier-type action grips firmly without excessive pressure. The set of the jaws and the direction in which the teeth exert force tightens the "bite" as resistance increases. One size handles objects from 3/16 to ¾ inches and a larger model has a range from ¼ to 1½ inches.

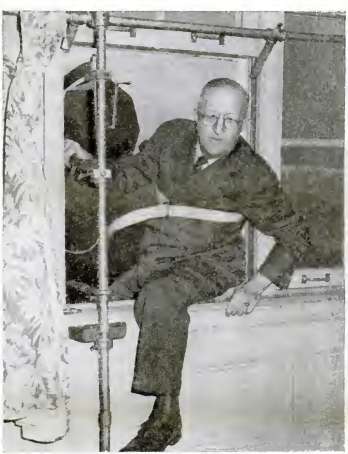
◖Men have been safely hurtled from planes flying 300 miles an hour in testing pilot ejector seats for jet and rocket aircraft.

Army Rolls Out First Four-Jet Bomber for Ground Tests

Secretly built at San Diego during the last two years, the Army Air Forces' first four-jet bomber has been rolled out for preliminary ground tests. Designated the XB-46, it has two General Electric turbojets in each low-slung nacelle. It is 105 feet 9 inches long, with a 113-foot wing span, and was built by Consolidated-Vultee.

Fire Escape Reel Lowers Person at Speed of an Elevator

People trapped in burning buildings are lowered to the ground at about the speed of an elevator by a new escape mechanism. The safety apparatus, invented by Irving Bassett, a Detroit barber, and his two brothers, consists of a steel ribbon wound on a reel regulated by a system of gears and a governor to assure a safe but speedy descent. The reel is mounted on the window frame of a building and swung outward in an emergency. The user steps into a loop on the end of the ribbon which slips tight around his chest. He then steps into space and the reel unwinds at a predetermined speed to lower him safely to the ground. In demonstrations the inventor, who weighs 160 pounds, descended 12 floors in about 18 seconds and landed without a jolt. The reel has a handle for rewinding the ribbon.



¶Experiments by the Army Chemical Corps have led to the use of flame throwers, spectacular weapons of the war, to melt snow and ice off airport runways.

Brother-sister act — Ruby and Bobby Maxson execute a "stag jump" in the Ice Follies of 1947

Putting a Show on Ice

THE homespun skating show that began on a frozen Minnesota swamp a decade ago is playing to a gallery of 3,000,000 people this year. That cheering gallery will pay out $4,000,000 to watch a carnival on ice that is a blend of musical comedy in waltz time, circus at the tempo of lightning and stagecraft that packs in all the miracles of radio controls and ultraviolet effects, of plastic costumes and mechanical props, that a staff of geniuses can dream up.

While the Ice Follies of '47 are rounding the country for the 11th annual circuit, the Ice Follies of '48 are being re-engineered and redecorated by a score of technicians at the year-round home office in San Francisco.

The Shipstads and Johnson, who started their career on ice with a troupe of 23 youngsters before an audience smaller than the cast, still carry in their trainload of performers 14 of that original troupe. But it is no longer a monopoly of the gay young blades of Minneapolis and St. Paul

▲ Snowman and the three bears prepare for their act. The snowman performs on stilt skates two feet tall

← Mae Ross glides across the ice in a graceful spiral

ice ponds. Stars from Switzerland and Canada race and waltz along with skaters from Omaha and Chicago. There's a young fellow from Charleston, W. Va., who has never skated outdoors, and a Brooklyn mother in her forties who takes four-year-old Susan along on her travels and who spends most of her time in the air executing acrobatic impossibilities above the ice.

Skating of the ballet variety, the slapstick comedy or the circus stunt is what the folks pay to see but the mechanical marvels are what make the show different each year. There is the $2000 Constellation plane model that "flies" across the arena and magically turns itself about for the return trip. There is the "ice-mobile" grand piano, circling the rink under the hidden power of an electric truck while a concerto is played. There are the portable light-control board and the glittering transparent plastic gowns and the battery of ultraviolet lamps that bring nightly sighs and cheers as they transform the dancing scene into a pageant of luminous color.

One of the magic effects being perfected during the current tour is a remote control

system by which a radio turns on a battery of lights inside translucent plastic columns spotted across the ice, without any connection to a power source.

But the mechanical Man of the Year is not one of the technical staff but a star skater, Harris Legg, who himself invented the flaming eggbeater through which he leaps with split-second timing in the brief moment when its revolving hoops are wide open. Back in 1933 Legg varied his routine of leaping over a long line of barrels by jumping through a stationary flaming hoop. In subsequent years the prop became a rotating single hoop, then a double one. While serving in the South Pacific some friends laughingly proposed that he invent a flaming eggbeater. So this year he added to his horizontally rotating hoops two inner hoops revolving vertically, operated on universal joints. All four hoops open in a flat plane for his jump for less than a second. The eggbeater itself is made of piping, and beneath it is a box containing a cylinder charged with propane gas, regulator valves, gearbox, air blower and quarter-horsepower motor. Orange flames spurt from 300 holes in the outer rims of the four hoops as he circles the ice with lightning speed to time his leap. In some cities, authorities have been reluctant to permit the use of flames. The Chicago fire marshal, however, changed

Werner Frick of the comedy team—Frick and Frack—defies gravity by skating with his head a foot above ice as his partner hurdles over him

Chorus wears plastic skirts and feature dancers cover skates with Fiberglas shoes in Dutch number

← Harris Legg jumps through four flaming hoops during split second they are open. Above, mount has tank that feeds propane gas to perforated hoops

Dumbo, a mechanical elephant operated by two men, waggles his ears, picks up articles by magnet in his trunk, squirts ground corncobs over spectators

In football sequence "coach" flips a reluctant player head over heels

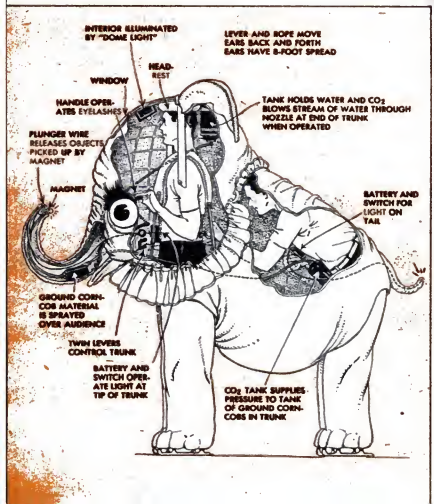
his ruling for later performances after a demonstration; there are only 200 cubic feet of gas in the cylinder, and the accidental touch of a skate on the eggbeater's hoops will stop the mechanism quickly.

The Ice Follies, pioneer of the three big-time skating extravaganzas, spends 11 months on the road touring 17 cities, always to sold-out houses; the Twin Cities provide a yearly highlight, the three-week stand in the old home town of Minneapolis being a sellout weeks in advance. Miami used to be on the schedule, but when skaters continually became lost in the fog that rose above the ice in the humid Miami arena that southern stop had to be canceled. The troupe of 165 performers and technicians travels in its own special train of six sleeping cars, a diner, lounge and six baggage cars.

The Shipstad brothers, Eddie and Roy, learned trick skating as kids, practicing on a local rink in St. Paul. The other partner, Oscar Johnson, grew up in the same neighborhood and became a speed-skating champion. Later he and Eddie teamed up to do a comedy vaudeville act between hockey games at Madison Square Garden. The three young men decided that entertainment on ice could have mass appeal, so they rounded up 23 neighborhood kids back in Minnesota and rehearsed a show. Their first season was a rocky one. No one had heard of watching a show on an ice rink. But repeat performances in the same cities the second season drew big crowds to see the "amateur" professionals.

The acts in today's program read like an old-time vaudeville card but they're presented

Mae Ross, as Gypsy Queen, poses atop the fire rock that contains a fan and lights. ← Sketch explains mechanical elephant



with the showmanship of a Billy Rose spectacle. On skates the actors have a smoothness and grace that can't be approached on dry land, their speed allows stunts that would be impossible on an ordinary floor.

One amazing and ludicrous act

This looks comfortable; try it yourself!

Evelyn Chandler performs difficult butterfly leap. Right, skate is sharpened against edge of grinding wheel cut to convex shape

is the gravity-defying performance of Werner Frick, who appears to rest on the air while moving at 20 miles an hour. Traveling sideways with his feet turned heel to heel, Frick bends his knees and lies back until his head and shoulders are only a foot above the ice. Common sense tells you that he can't hold the position and yet he continues to move around in wide curves with his body parallel with the ice while the spectators howl with glee.

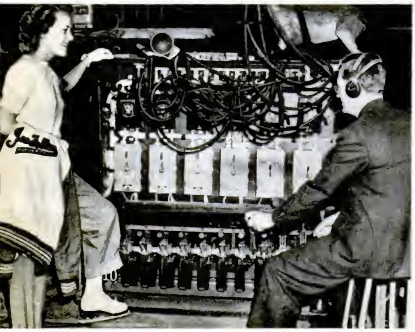
Offstage, Frick explains that centrifugal force holds him up during this cantilever spreadeagle. After spreading his feet he sets the inside edges of his blades and leans back just as if he were banking around a curve. The stunt sounds simple but Frick has few imitators.

Front-row spectators gasp when a speed skater sprints straight at them, apparently intent on crashing into them. Then, just as he reaches the edge of the ice, he comes to a dead stop. Shaved ice from under his blades showers over the front rows.

Speed-stops like these are faster than emergency stops by an automobile. Harris Legg, for instance, is traveling more than 30 miles per hour when he lands within yards of the spectators after hurtling over a long row of obstacles. But he stops in three or four feet. The terrific deceleration is obtained by turning the feet broadside and lying back, setting the blades into the ice.

Then there's Dumbo, the two-man elephant that shambles across the ice on the skates of Ole Ericsen and Jim Hutchinson. Ericsen wears football shoulder pads to support the head and trunk and guides him-

George Voorhies, chief electrician, explains mobile control board used for auxiliary lighting effects



"Ice-mobile" grand piano is powered by an electric truck; it circles ice rink with maestro at the keys

Traveling 30 miles an hour, Harris Legg makes a speed stop in three or four feet. Right, Evelyn Chandler does a high leap

self by peering through small windows in the cloth head. Hutchinson brings up the rear and sees only the ice between his feet.

Inside the elephant's head are so many strings, levers and controls that Ericsen needs a small overhead light to see what he's doing. One set of levers wiggles the huge ears, another blinks the eyes, a third lowers and raises the trunk. Dumbo picks up wire-stemmed flowers from the ice by means of a magnet in the end of his trunk. He sprays water into the air when Ericson releases a siphon of water through the trunk, and shoots ground corncobs over the spectators when another control is pulled.

Each show is planned for 12 months before it appears on the ice and as much as a third of a million dollars is spent for a season's costumes and properties. This year's show features huge plastic flowers in transparent vases, striped plastic hourglass skirts for the dancers and large Fiberglas boats with transparent sails.

Precision dance numbers on the ice are particularly beautiful because the girls are

(Continued to page 252)

Rear and front views of stage backdrop; scenes are painted on single curtain which is rolled up and down like a window shade. This system saves space and time in shifting scenes—an operation performed in dark

Radio Waves Shoot Through Walls For Complex Industrial Jobs

"Seeing" through walls and around corners is accomplished by a microwave unit which combines characteristics of radar and the electric eye. Unlike an electric eye, however, the microwave device "sees" by high-frequency radio waves instead of a light beam. By means of a parabolic reflector, microwaves are focused in a beam and reflected from objects in the same manner that radar impulses and a beam of light are reflected, according to General Electric electronics engineers. Like the photoelectric cell, the microwave unit can be used for counting, opening, closing, signaling or discarding—but through a wall, partition or housing, if necessary.

Cartridge in Spearhead of Harpoon Explodes When It Hits Target

In a unique fishing harpoon, the spearhead is driven deep into the target by a .22-caliber cartridge fired upon impact. The spear was devised by F. W. Johnson of San Diego, Calif., a spearfishing enthusiast, in an effort to improve the accuracy of his harpoon casts. So that the point will penetrate the fish, it is ordinarily necessary to throw a harpoon with such force that accuracy suffers. With the cartridge-fired spearhead, the harpoon can be thrown with less force and more accuracy. The impact of the harpoon against the target causes the cartridge to fire, driving the detachable spearhead deep into the fish. The point is secured to a line by which the fisherman retrieves his catch. A safety device on the harpoon prevents accidental misfiring.

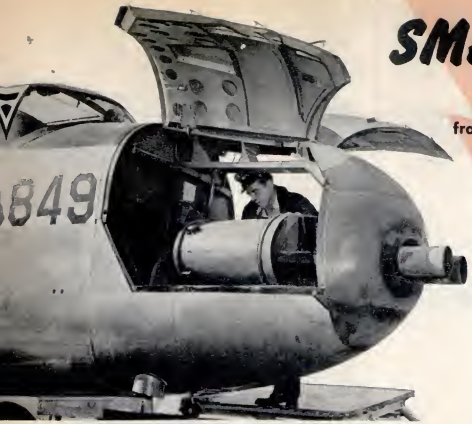
Instrument Gauges Rough Surfaces By Flow of Compressed Air

Roughness of sheet rubber is measured by a instrument that computes the rate of escape of compressed air across the surface. The instrument, called a rugosimeter, was developed by the United States Rubber Company to gauge the roughness of rubber sheeting used for footwear and other products. A round steel weight is placed on the surface to be tested and compressed air is introduced between the weight and the sample through a hole in the weight. If the surface is rough the air escapes easily through the "valleys." If the surface is smooth the air has difficulty in escaping.

You may wish to obtain additional information about the new products described each month in Popular Mechanics. If you want to know the name and address of the manufacturer or distributor, just write to Bureau of Information, Popular Mechanics, 200 East Ontario Street, Chicago 11, Ill.

SMASH HITS

Three pages of pictures from the Navy's rocket laboratory at Inyokern, California



Crew member loads five-inch spinner rockets into first magazine-type rocket gun carried inside an aircraft. The gun, a double-barreled revolver, can fire a salvo of 10 rockets

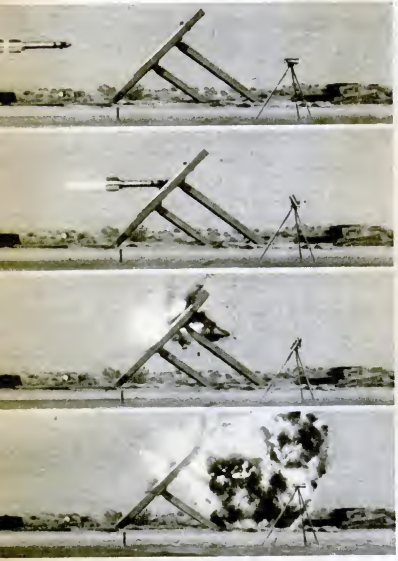
ROCKET missiles packing a superwallop are crashing through targets in tests at the Navy's new ordnance station at Inyokern, California. The station is a section of the Mojave Desert as big as the state of Rhode Island.

One of the new weapons under test is the first magazine-type rocket gun to be carried inside an aircraft, supplanting rockets that are attached to the wings or fuselage. It's a twin revolver that fires five-inch spinner-type rockets, as many as 10 in a salvo, giving the airplane the fire power of a cruiser. The

↑ Searing flame jets out through exhaust stack of the test ship just before rocket emerges from its tube
↓ Two rockets streak from the plane's nose in the first ground test of new weapon designed for air combat

↑ Double motors give an 11.75-inch rocket airplane speed when it's launched from the 1500-foot test track

↓ Strip photos show the same rocket penetrating a 2½-inch armor-plate target and exploding just beyond



↑ Note marks left by fins when rocket penetrates target

↓ Ordnance experts examine opposite side of the armor

↓ PBJ Navy bomber releases a dummy Tiny Tim rocket in a drop test above the Mojave Desert ordnance range

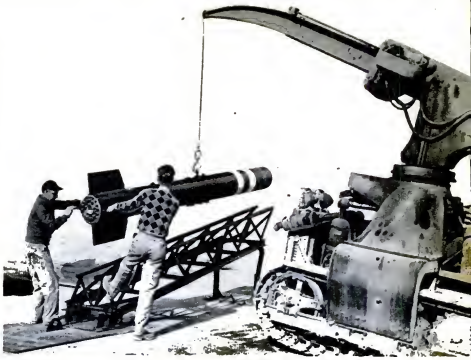
magazine rotates as the rockets are fired and can be reloaded by the crew from inside the plane.

The Tiny Tim, an 11.75-inch rocket developed as an air-to-ground missile during the war, is undergoing new tests as a special purpose weapon. Twin rocket motors have been installed on some of the missiles in ground tests to give them aircraft speed at launching. They are launched from a special 1500-foot rail covered with a sheet metal canopy to reduce temperature changes. In service, the Tiny Tim carries a heavy charge of TNT fused to explode immediately after the target has been pierced.

Still bigger than the Tiny Tim is the 14-inch rocket recently announced by the Navy and now under test at Inyokern. Known as the Richard, the new missile is powered by solid fuel and is one of the largest short-range rockets that have been developed, exclusive of the big directed-missile types. Zooming through the air with the sound of a gigantic blowtorch, the Richard carries a heavier high-explosive charge a greater distance than the Tiny Tim.

They're testing other methods of warfare on the great Mojave range, too. There the Navy not long ago demonstrated its new aerial bombing technique called "toss bombing." The toss-bomber pilot dives toward his target from a great height and distance, pulls out of his dive, and releases his bomb as he is climbing upward again. The missile moves toward the target in a great arch, sometimes traveling a mile beyond the point of release.

In order to toss the missiles accurately, an ingenious new bombsight called the Mark Three Toss Director has been developed which automatically computes the plane's air speed, altitude, angle of dive and distance to the target. When the instrument has completed its calculations a red light flashes. The pilot then can pull out of his dive and the instrument releases the missile at the right moment. The pilot is not required to dive right at the target but can drop his bombs from some distance away to avoid antiaircraft fire.



↑ New solid fuel 14-inch rocket, one of the biggest, is loaded on its launching rails for a firing test

↓ A Richard zooms toward target after leaving rails

↓ Fighter plane suspended from a special tower fires a big Richard rocket during a simulated flight test

From Trading Post

Utah's centennial recalls an inspiring past and points to a bright future for a land once so desolate that no one wanted it

THIS SUMMER Utah celebrates 100 years of progress since Brigham Young gazed across the arid wastes of Salt Lake Valley and told his Mormon followers: "This is the place."

The "place" was so desolate that the Mormons hoped that no one else would ever want it. Driven out of the Middle West, the group had traveled over 1000 miles to find just such a sanctuary. Forbidding mountains rose up in the east and to the west there was little but sterile desert. The vast lake that shimmered in the distance was as useless as a mirage—it was too salty to drink. The whole region was unexplored; except for a few wandering Indians it was uninhabited.

The Mormon pioneers didn't know that they had chosen an area that abounds in natural wonders and that later would be called the center of scenic America. They weren't aware then that irrigation water from the mountains would transform the barren ground into rich soil. They didn't realize, either, that there were billions of tons of copper, coal and other ores under their feet.

The first company of 148 people laid out their temple grounds, surveyed and plotted Salt Lake City and established farms on which they hoped to live in peace. They never really had any isolation because the gold rush to California in the early '50s promptly turned Salt Lake City into a trading center. By 1852 the population of the area had grown to 15,000. Local mines were

Land of scenic contrasts, Utah abounds in natural wonders. Erosion carved the grandeur of Monument Valley

to Empire

Vacationists on horseback are dwarfed by the craggy towers of a rock bridge in the Cedar Breaks country

opened and Utah settled down as a territory. In 1896 it became the 45th state to be admitted to the Union.

This year's centennial celebration commemorates both the past and the future, for Utah is becoming an industrial state of increasing importance. Pioneer pageants are to be held in all of Utah's cities and towns during the summer. A state exposition opens in Salt Lake City June 1 and will continue until fall. Seven national sports events will be staged during the season, together with aquacades, ice follies shows, art exhibits and symphony orchestra concerts. The celebration will last all summer and will attract tourists from all parts of the country. The visitors will get their money's worth out of the scenery alone.

Possibly nowhere else but in Utah can you fish for trout, hunt deer, acquire a desert tan, ski in snow, excavate bones of pre-

Pneumatic-tired scoop stock-piles salt crystals in drying beds

historic animals, gather relics of ancient Indian tribes and prospect for gold all in the same day. There are a dozen other novel pastimes that you can try if you run out of things to do, from testing your car's top speed on the Bonneville salt flats to trying to swim under water in the Great Salt Lake. The last is possible but extremely difficult.

The lake, 75 miles long and 35 miles wide, is the concentrated residue of vast Lake Bonneville that during the glacial age covered one third of the entire state. The water gradually receded, principally by evaporation, with the result that the present Great Salt Lake has a saline content of 25 percent. A century ago the pioneers pickled beef and buffalo meat in the water. Table salt, sodium sulphate and other salts are refined from great evaporation beds along the lake's shores today. It is estimated that the lake contains six billion tons of salts.

Its water weighs 12.5 pounds more per cubic foot than does fresh water and people can float in it without effort. Conventional life preservers are never needed. Only an unconscious person floating face down could drown. The recommended life preserver in such a case consists of a 15-pound weight attached to the legs to keep the head in the air.

Power shovels load long strings of ore cars with salt taken from a high stock pile of crystals on the beach of Great Salt Lake

Sixty miles west of Great Salt Lake are the Bonneville salt flats. The dazzling snow-white surface is 20 miles long, almost as hard as concrete and as level as a table top. The crystal pavement is from one to six feet deep. The world's automotive speed and endurance records were established there.

Prehistoric beasts roamed the palm and bamboo forests that flourished in the great basin area during the Lake Bonneville period, and the remains of these monsters are now found at scores of sites up and down the eastern side of the state. Fossil remains of flying reptiles, footprints of giant three-toed lizards, leg bones as tall as a man, and the vertebrae of mammals that weighed 20 tons and measured 100 feet in length have been excavated from cliffs and bluffs. One of the richest of these boneyards, from which thousands of bones including 22 complete saurian skeletons have been removed, is now preserved as the Dinosaur National Monument on the Utah-Colorado border.

Ancient man roamed over the same region and left his mark in the form of old campsites, gnawed sloth and camel bones, rock carvings and cliff dwellings. Still a puzzle to archeologists are the weird stone towers and buildings that some early race erected in southeast Utah. Hovenweep National Monument has been set up to protect them.

Many of Utah's famed scenic spots are in the southern part of

the state and all but two of these may be reached over good highways. Most of southern Utah is typical desert country dotted with mountain ranges and occasional 8000 to 10,000-foot peaks. Travelers who leave the main highways are advised to carry plenty of water. Dirt roads alone, for instance, lead to Monument Valley inside the Navajo Indian Reservation extending into Arizona. The valley takes its name from the multitude of vertical-sided and flat-topped crags that it contains, the tops of which mark the plateau from which the valley has been eroded.

You can reach Zion National Park over good highways. This region is noted for the range of colors and odd rock formations on the walls of its canyon. One entrance to the park is via a 5600-foot highway tunnel that pierces the heart of a mountain.

Cedar Breaks National Monument, not far from Zion, is a wildly colored badlands in the form of an amphitheater half a mile deep and two miles from rim to rim. Bryce Canyon National Park, also in southern Utah, contains spectacular spires and pinnacles that rise nearly a thousand feet above the floor of the canyon. Capitol Reef National Monument, also in the same region, consists of a tremendous 20-mile-long reef or upthrust that in addition to fantastic eroded formations contains numerous petrified forests and archeological remains.

Open pit mine at Bingham produces one third of nation's copper

At nearly any time of the year you will find one or more Hollywood movie groups on location in one of the parks or in the surrounding area. Many of Hollywood's big color features are filmed in part in Utah. At Cedar City, adjacent to several of the parks, one busy enterprise rents saddle horses, herds of cattle, covered wagons and other pioneer equipment to the movie companies. A movie village near Zion is in use for months on end.

Natural bridges are a rarity in most parts of the world but not in Utah. The Arches National Monument alone contains 81. Considerably larger are the three big rock bridges in Natural Bridges Na-

Coal veins spread under 13,000 square miles of Utah's surface

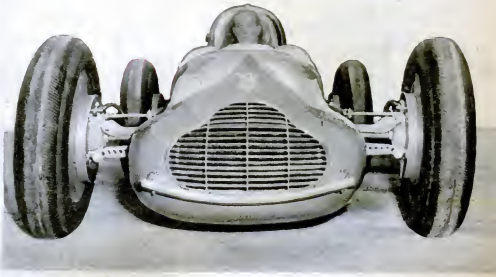
Mormon Temple in Salt Lake City is world-famous. Eroded spires, above, in Cedar Breaks National Manument attract many tourists

tional Monument. The largest known is Rainbow Bridge. Its curved rock arch is 278 feet long and 309 feet above the streambed below.

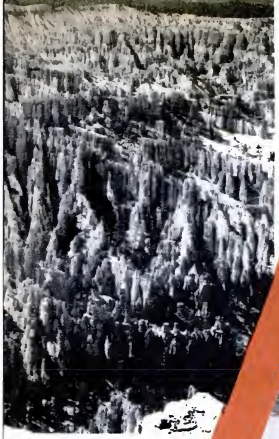
Utah's mines produce nearly a third of the nation's copper plus important amounts of gold, silver, lead and zinc. The state has rich deposits of tungsten, vanadium and molybdenum, and some uranium. It is rich in phosphates and oil shale and there are coal deposits under 13,000 square miles of its lands.

Its newest large industry is steel production. Geneva Steel Company's $200,000,000 plant 40 miles south of Salt Lake City gets its ore from Iron Mountain 225 miles to the southwest, its limestone and dolomite from quarries 25 miles away, its coal from a mine 130 miles southeast and its water from artesian wells and the nearby Wasatch Mountains. Now operating at partial capacity, Geneva has a potential output of 1,280,000 net tons of steel ingots per year. Its production is increasing and subsidiary industries are moving in.

Too, Utah is an export state in canned, frozen and fresh vegetables and fruits. It refines large amounts of sugar from its own sugar beets. It is a leader in livestock. Salt Lake City is the trade and distribution center for the intermountain region.



Records may fall when racing driver Ab Jenkins drives this car in a 24-hour-long speed run over Bonneville salt flats

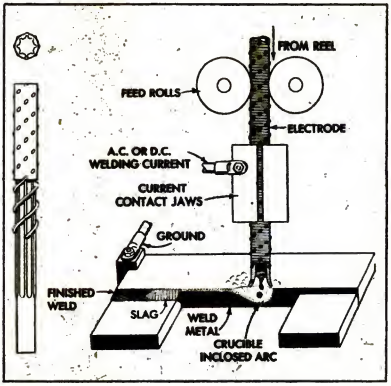


Almost on the edge of the desert, mountain ski runs operate from November to June. Blast furnaces, bottom, of steel mills are changing the industrial profile of Utah

All this is accomplished by a relative handful of people. Utah's population of 600,000 is less than that of metropolitan Buffalo, although the state's 84,916 square miles of area is equal in size to the states of New York, Massachusetts, Connecticut, New Hampshire and Vermont combined. Much of the population lives in an agricultural and industrial belt east of Great Salt Lake, extending from Logan through Ogden and Salt Lake City to Provo. Extensive farming goes on in the long north-and-south valleys between the mountain ranges that reach down toward Arizona. Most of the state is at elevations of from 4000 to 6000 feet. The climate ranges from dry semitropical in the south to temperate in the north.

Utah calls itself the Beehive state. If the next 100 years are as busy as the first, it's the right name for the isolated trading post that has grown into an empire.

Welding Electrode Withstands Bending Without Any Loss of Flux



Advantages of both the manual shielded arc welding process and continuous automatic welding are combined in a continuous feed welding electrode. Metallic grid construction binds a heavy flux coating to the wire core to provide an electrode that withstands extreme flexing and bending without loss of flux. At the same time the electrode can be fed continuously into a mechanically maintained arc from a reel.

Border Guards Use Spotlight-Mirror to Peek Under Car for Contraband

No longer do U. S. customs inspectors at the Texas-Mexico border have to crawl under automobiles to look for hidden contraband. They now use an inspection device equipped with mirror and spotlights which is pushed under a car to examine the undercarriage. Metal rods welded together in a rectangle support the mirror and lights. A handle at one end and wheels at the other make it easy to move the contrivance. It was designed by David C. Ellis, young El Paso, Texas, customs inspector, to reduce undercarriage inspection from three minutes to 20 seconds—and eliminate a lot of backaches. A 20-foot extension cord supplies power to the two sealed-beam lights.

Temperature Taken in Blood Stream

Electric thermometers measure blood temperatures directly in the blood stream. The sensitive part of the apparatus, known as a thermistor, is embedded in a glass bead which is 1/25 inch in diameter. This is encased in the tip of a rubber tube so slender it can be pushed through a hollow needle inserted in a blood vessel. From the thermistor a pair of slender wires leads back to a small box containing apparatus for measuring changes in electrical resistance. By noting these changes, blood temperatures can be determined within a range of 97 to 133 degrees Fahrenheit.

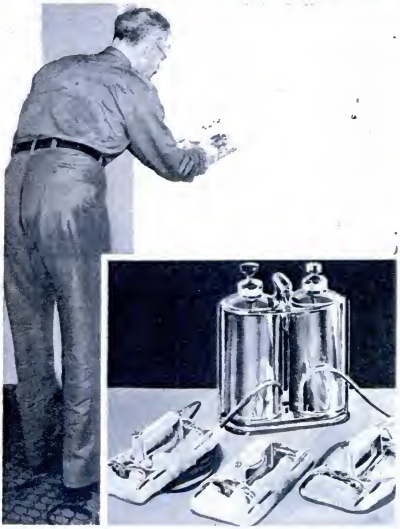
Hulls of PBY Flying Boats Are Converted Into Seagoing Cruisers

Photos by Clary

With tails clipped and converted auto engines added, abandoned PBY hulls become sleek salt-water cruisers

Converted into streamlined cruisers, the hulls of retired Navy PBY flying boats have gone back to sea. Ingenious Seattle yachtsmen bought the hulls, stripped of wings, at auction for $100. To convert them into seagoing cruisers, the tail was clipped leaving a hull 30 to 45 feet long. Built of an aluminum alloy impervious to salt water and with watertight compartments, the clipped PBYs are seaworthy boats.

Pressure-Fed Trowels of Wall-Washing Machine Speed Cleaning Job



Time required to clean walls is reduced by a wall-washing machine which employs cleanser and rinse water under pressure. Designed to eliminate the annoyance of streaking and dripping, the machine applies cleanser and rinse water through large trowels covered with cloth pads. The liquids are fed into the pads by pressure storage tanks.

Steam Draws Oil From Shale

One of the most efficient methods of extracting oil from low grade shale was developed by desperate Germans during the closing days of the war. They produced limited quantities of oil from shale deposits in Wurttemberg. Shale was heated in a retort. Then steam, superheated to 800 degrees Centigrade, was passed horizontally through a downward-moving mass of crushed shale. Oil vapors and gases passed out the opposite side of the retort along with steam to be recovered later. The remaining shale was usable as hydraulic lime or for making cement.

"Gas Tank" Auto Powered by Batteries

Scooting along the highways near Buffalo, New York, is a midget automobile built by J. Fred Schoellkopf from a surplus warplane "belly tank." The tank became a car with the addition of electric motors, diminutive wheels and a few other trimmings. The little vehicle rolls along at 15 miles an hour and has a range of 40 miles, 20 from each of two automobile batteries, before the batteries must be recharged.

Alarm System With 15 Thermostats Registers Both Heat and Cold

Warnings of cold damage as well as fire alarms are registered by an electric alarm system for farms and industrial plants. Fifteen thermostats are spotted in danger areas and connected with a thermostat in a main building. When there is a critical rise in temperature at any of the locations a bell in the control unit rings, a red light glows and a dial indicates the location of the fire. The "cold" thermostats of the system can be placed in brooder houses or greenhouses to warn of drops in temperature. If a wire or thermostat is broken anywhere in the system the alarm bell rings and the dial indicates the area of damage. Each of the 15 thermostats in the system is effective over an area of 4800 cubic feet and as many as 300 auxiliary thermostats can be added to the unit.

Plastic Card Holder Aids Rummy Play

One card at a time is released by a plastic holder designed to prevent accidental two-card draws in rummy and other card games requiring single-card draws. It also keeps cards from blowing away when playing out of doors. A pull drawer in the bottom of the device holds one deck and also serves as a convenient discard tray. The holder is four inches wide and seven inches long.

Remote Control Keys Run Typewriter

Remote control typewriters, designed for bedridden and seriously disabled persons, are in use in veterans' hospitals. The remote control keyboard of the machine can be operated in any position. Striking the letter keys on the keyboard transmits electrical impulses to the typewriter.

Wallpaper Remover Dissolves Paste

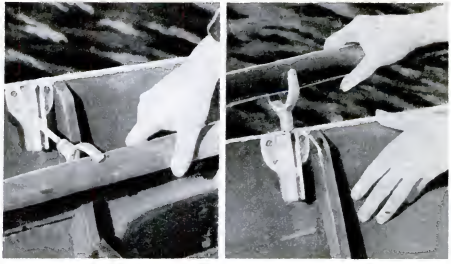
Wallpaper can be peeled off easily after applying a new remover that penetrates and dissolves the paste. It is odorless and the quick acting chemicals won't harm woodwork, painted surfaces, clothing or the skin. The remover comes in powder form, and a two-ounce jar dissolved in hot water is enough for an average-size room.

Sealed Beam Spotlight for Autos Projects Glareless Ray ½ Mile

←Sealed beam spotlights for automobiles and boats cast a concentrated, glareless ray for half a mile. A peacetime "sister" of the landing lights used on warplanes, the spotlight has a sealed disklike reflector and a tungsten filament. A parasol-shaped filament shield eliminates stray light and prevents blinding glare in the area between the observer and a distant object being illuminated. Westinghouse engineers, who developed the light, report that its ray is four times more powerful than that of a sealed beam auto headlight.

Theftproof Locks Prevent Oar Loss →

Oar locks that consist of three units prevent theft or loss of oars. Made of manganese bronze castings, the locks consist of a vertically slotted bracket permanently attached to the inside of the boat, a conventional oar lock with lock-rod and a cross-rod passing through the oar handle. The cross-rod prevents the oar from slipping out of the flexibly anchored oar lock. The lock-rod on the bottom of the oar lock terminates in a ball sealed in the slotted bracket. This serves as a ball-bearing socket and also prevents lifting the rod or the attached oar out of the anchored bracket.



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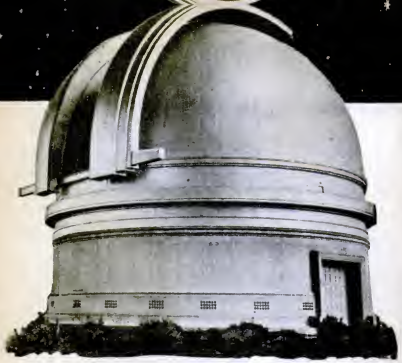


The rotating part of the Palomar observatory dome weighs 1000 tons, is insulated with aluminum panels

By Thomas E. Stimson, Jr.

THOUSANDS of visitors every month are driving to the top of Palomar Mountain near San Diego to inspect the giant 500-ton telescope that in 1948 will begin to probe unknown reaches of the universe.

Inside the observatory dome they gasp at the size of the five-story-tall instrument. They marvel at the ingenious engineering by which the massive parts will be made to move in tracking distant stars. The Palomar telescope is one of the wonders of the modern world.

Meanwhile, in the optical shop at California Institute of Technology in Pasadena, the telescope's mirror disk is undergoing final shaping. Precision work is being done that has no parallel in history.

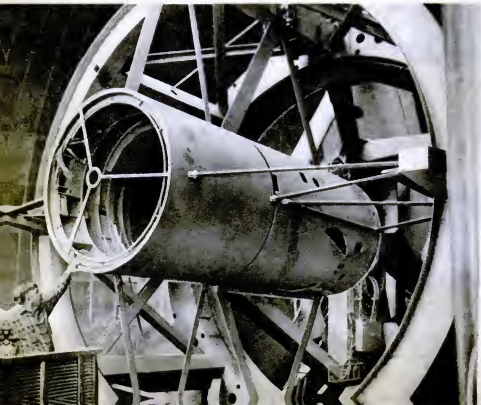
At Palomar the telescope's structural parts must be true to a thousandth of an inch; at Pasadena, a millionth of an inch is acceptable tolerance. No mechanical measuring device can be calibrated so finely, so technicians use the wave length of light, 1/50,000 inch, as their yardstick.

The 200-inch Pyrex disk, almost 17 feet across, received its rough grinding before the war. Two tons of glass were removed in the process of grinding out the spherical concave surface. Now the opticians are polishing this surface and deepening it to the shape of a parabola.

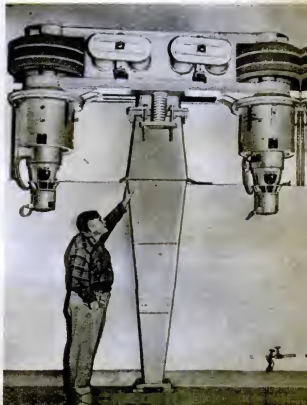
The glass disk rotates on a big turntable. Above the disk, a traveling crane moves back and forth, its weight supported by tracks on either side of the turntable. Suspended from the crane's cross member is the flat, round polishing tool. The polishing medium is a thin solution of flour-smooth red ferric oxide suspended in water.

Only one third ounce of glass is removed in a week. For weekly inspection, the glass disk is tilted down from its turntable and given the knife-edge test. This method is used by amateur astronomers to check surfaces they grind and polish by hand. In this test the mirror disk is viewed through a narrow slit formed by two razorlike pieces of metal. The perfect portions of the glass surface reflect light from a lamp placed near the test apparatus. The zones in the surface of the mirror that do not reflect light

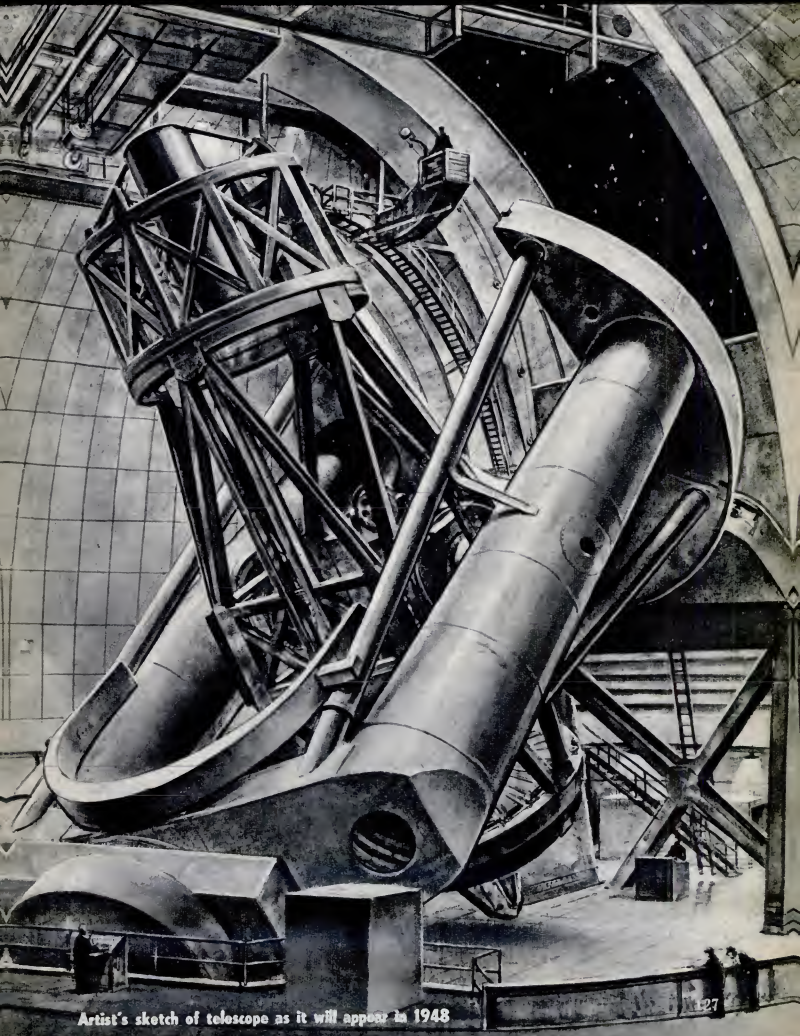
When the giant telescope is completed, certain observations will be made from the "prime focus" platform on which this man stands



Five-horsepower motors, "geared" to the wall by rubber tires, will turn the dome



WONDER OF THE WORLD



Artist's sketch of telescope as it will appear in 1948

CUTAWAY DRAWING OF 200-INCH TELESCOPE

PHANTOM DRAWING SHOWS HOW OBSERVER GETS ON AND OFF TUBE

CRANE TRACK

TELESCOPE CAGE

PRIME FOCUS f 3.3

60-TON CRANE

PRIME FOCUS PLATFORM

COUDE & CASSEGRAIN MIRRORS

DOME, 137-FT. DIAMETER

HORSESHOE, NORTH POLAR AXIS BEARING

DOME SHUTTER 30-FT. OPENING

DECLINATION AXIS

RIGHT ASCENSION DRIVE

NORTH PRESSURE BEARINGS

PASSENGER ELEVATOR

200-INCH MIRROR

CASSEGRAIN FOCUS f 16

COUDE FOCUS f 30

NORTH CONTROL DESK

CONSTANT-TEMPERATURE ROOM

DOME DRIVE

AIR-CONDITIONING DUCTS

DOME TRUCKS

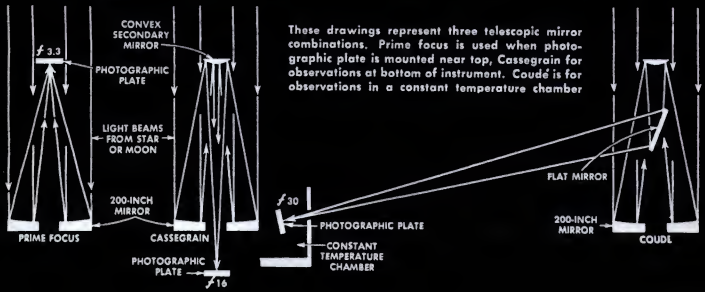
SOUTH POLAR AXIS BEARING

GROUND FLOOR

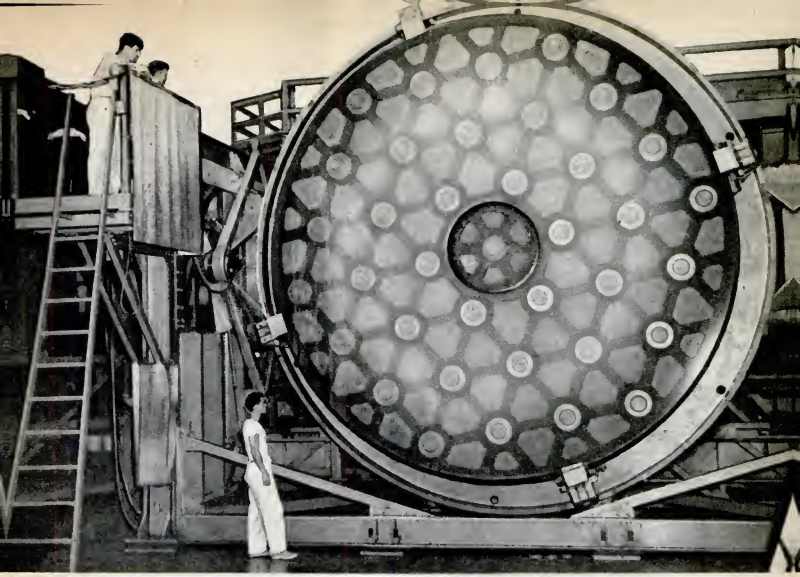
OFFICES

OBSERVATION FLOOR

ELECTRICAL CONTROL PANELS



These drawings represent three telescopic mirror combinations. Prime focus is used when photographic plate is mounted near top, Cassegrain for observations at bottom of instrument. Coudé is for observations in a constant temperature chamber



Mirror disk for the 200-inch telescope is tilted down from polishing turntable for surface inspection. Below, slip-ring trolley system will distribute power

to the focal point appear to be in shadow.

This past winter the 200-inch disk was virtually perfect except for one shadow zone about $\frac{1}{25,000}$ inch deep. Polishing the rest of the surface with specially shaped tools was begun so that the whole surface could be brought into a perfect curve. Before the technicians finish their task, they expect to make the surface accurate to within 1/1,000,000 inch of the ideal curve.

A speck of grit so small you couldn't feel it would ruin the glass surface at this stage of polishing. For this reason no visitors are allowed in the optical laboratory. They may view the scene only through a glass partition from a visitors' gallery.

The opticians themselves change from street clothes and shoes to special garments before entering the laboratory, then change their shoes again to a third pair before mounting the polishing machine. The entire laboratory floor is swept twice daily with a vacuum cleaner and a magnetic sweeper that picks up all particles of magnetic metal. Filtered air is admitted to the laboratory all night; in the morning the fans are shut down. Thus, the air is dead and still during the working day.

Laboratory temperature is balanced so that on even the hottest day outdoors it

Drawings by Russell W. Porter

Cutaway view shows declination drive and control mechanism in tubular arm

has a range of only half of one degree from floor to ceiling. Insulation keeps the temperature virtually constant—a three-degree change could expand the glass disk and the polishing tool at unequal rates, causing the tool to cut a distorted shape.

Some time this summer or fall, tests will show that the glass surface has been polished to perfection. Then the disk will be trucked to Palomar, 125 miles away, and placed in a huge vacuum chamber where it will receive its reflective coating.

The only function of the glass disk on which so much work is being done is to provide a stable support for an aluminum film, 1/1,000,000 inch thick, to be spread over its surface. The film will be deposited on the glass surface in the vacuum aluminizing chamber by a process somewhat like evaporation. Next, a transparent protective coating of pure quartz, one or two wave lengths deep, will be deposited on the aluminum by a similar method. This coat will reduce the rate of oxidation of the aluminum reflecting surface, will permit cleaning and give the aluminum surface a life of about 25 years. After that the aluminum will be renewed.

Because of its weight and size, so huge a mirror would be subject to all sorts of distortions when placed in some positions. The disk would sag out of shape when tilted one way or stretch enough to spoil a perfect focus when tilted another. To eliminate deformations the disk is to be held inside a ¾-inch-thick steel pan that will support it and provide fulcrum points for 36 automatic counterbalances set into the rear of the disk. Each counterbalance will support the weight of its portion of the mirror. Each is made up of 1100 machined parts and is adjustable to push directly against gravitational pull. The counterbalancing apparatus is expected to hold the big mirror true to within 1/10 a wave length of light no matter in what position the mirror is placed.

The telescope, minus its mirror, is being tested now. To check its motions, a concrete block equal in weight to the mirror has been installed temporarily in the telescope.

The telescope is in a mount that enables it to be pointed toward any part of the sky from the North Pole to the southern horizon. Intricate automatic control mechanisms turn the instrument so as to offset the rotation of the earth and keep the study object in view.

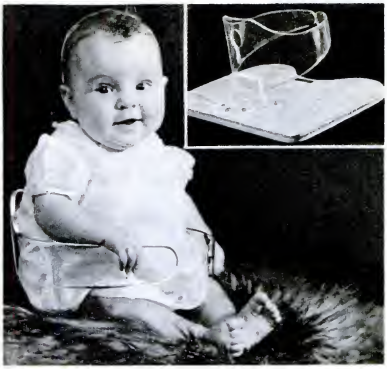
In other reflecting telescopes a small flat mirror is placed diagonally in the shaft above the main concave mirror so that the concentrated light from a star may be reflected to a suitable point for study. The Palomar instrument is so huge that for some purposes the observer himself will take the place of the diagonal mirror. He will sit in a cylindrical housing suspended in the open tube over the mirror. Various arrangements of mirrors also may be used for obtaining various focal lengths for special types of studies.

The 100-inch telescope on Mount Wilson, now the largest in use, has revealed star clusters at distances of half a billion light years away. A light year is nearly six tril-

(Continued to page 264)

Transparent Plastic "Baby Poser" Holds Children for Photographs

Seats made of transparent plastic may solve the biggest problem of baby photography. The seat holds a squirming baby in an upright position without interfering with the natural movements of his body. The arms of the "poser" are spread apart to place the baby on a wooden seat.



Bubbles Trapped in Concrete Strengthen Pavement

Air bubbles are trapped in concrete to counteract chemical attack and to increase resistance to frost action. The air pockets are flexible enough to adjust themselves to the movement of grains in the concrete and they resist the chemical action of salts used for de-icing pavement. Pine resins, animal or vegetable fats and oils are added directly to the cement or introduced at the concrete mixer to produce the bubbles. Favorable tests of air-impregnated pavement have resulted in the use of similar concrete in buildings.

Poker Rack Counts Stacks of Chips

Stacks of poker chips are counted and released instantly by an adjustable selector attached to a plastic case that holds 280 chips and two decks of cards. From one to 35 chips are dispensed by setting a dial and lifting a lever. A locking cover fits snugly over the case and keeps out dust.

¶Incandescent lamps convert only two or three percent of the electrical energy consumed into light rays, says the Better Vision Institute.

Spool-Size Motor Used on Ships

Almost small enough to slip into a watch pocket, an electric motor 1⅝ inches in diameter and 2⅝ inches long is completely enclosed to resist corrosion caused by dampness, particularly salt water. In tests the motor has stood up under salt-water sprays for more than 200 hours, proving its usefulness in ships and planes for fans, blowers, vacuum pumps and control of radios and instruments. The motor can be "tailored" to operate from 2000 to 20,000 revolutions per minute on alternating or direct current or both, ranging from six to 230 volts.

Glider Descends Vertically

Without wings or an engine, a "trailer" glider now being tested can descend almost vertically, more slowly than a parachute. Towed aloft and released like a standard glider, it is eased to earth by two nine-foot horizontal revolving blades. The craft weighs only 120 pounds but can carry an additional 300 pounds. Known as a Gyro-Glider and developed by General Electric, it is expected to have commercial use for reaching isolated regions without adequate landing facilities for conventional aircraft.

Radioactive Bar Removes Static Electricity From Photographic Prints

Static electricity is removed from photographic prints as they roll off the drum drier by a radioactive metal bar that prevents the prints from adhering to each other or to the drum. The static eliminator consists of a shielded radioactive strip fastened at the discharge end of the drier where the static charge tends to increase. Alpha rays from the radioactive source ionize the air, which then acts as a conductor to remove the charges as they are generated. The unit, acting without a power source, has a permanent action directed toward the prints, so that radiation effects are negligible except at the point desired. It can be installed on standard automatic drum driers.

Split Wave Transmits Two Messages

Two different transmissions, one a voice broadcast and the other a radiotype message, can be carried on the same wave length over a dual-purpose radio system invented by Walter S. Lemmon, president of the World Wide Broadcasting Foundation. In ordinary broadcasting the demands for wave lengths far exceed the number of bands available. The new system doubles the number of channels that can be used for transmission. A crystal on the short-wave transmitter "splits" the wave by changing very slightly the wave length of one of the messages. The two transmissions then travel together but are independent of one another. Receivers for the two messages can be together or far apart. A special electronic attachment in the receiver is tuned to pick up either transmission, eliminating the one not wanted.

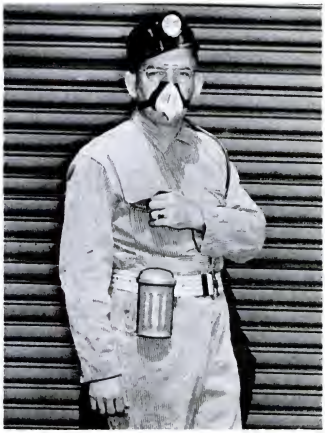
Campus "Village" of Steel and Aluminum Homes Set Up in 90 Days

Steelcraft Manufacturing Co. photos

Spurred by the needs of student veterans with families, a "village" of 100 packaged steel and aluminum homes was set up on Northwestern University's campus in 90 days. Each home has two bedrooms, combined living and dining room, kitchenette and a shower stall in the bathroom. Normally unused overhead space was fashioned into convenient book shelves.

Safety Dress for Coal Miners Guarantees Protection From Head to Toe

To insure the utmost in safety, the well-dressed coal miner and other underground workers wear equipment that guarantees head-to-toe protection. Attached to the crashproof helmet is a safety lamp. Spectacles are shatterproof. A featherweight dust mask prevents the inhaling of respiratory irritants. Coveralls are tied at the shoe tops and a self-rescuer is buckled on at the safety belt. Shoes are high-topped and hard-toed.



Radioactive Gas From Bikini

Radioactive gas was detected in the atmosphere over Oklahoma three days after the second Bikini atomic bomb exploded, according to a recent report by five Tulsa scientists. An isotope of radon, a rare gas normally released by the disintegration of radium, was discovered in the air. Scientists throughout the world attempted to detect atmospheric changes caused by the bomb but results recorded in most locations were negative. A marked increase in gamma rays was reported at Houston, Texas, after the first bomb exploded at Bikini.

POWER FOR THE AIR AGE

World's largest, the 5000-horsepower Lycoming above equals the combined might of the surrounding lightplane engines. It has 36 cylinders, weighs 6050 pounds and would use 580 gallons of gasoline hourly at full power

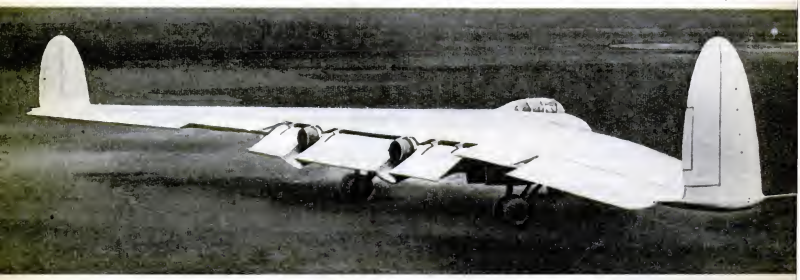
By Aubrey O. Cookman, Jr.

RECENTLY, the director of one of the world's largest aeronautical laboratories was showing a visitor around the place. After roving over acres of test space, mainly devoted to jet research, they finally came to a conventional piston engine.

"We keep one of these around as a curiosity," the director explained.

Although he smiled when he said it, the remark is a tip-off to the thinking of aircraft engineers who must stay five to ten years ahead of their time. Where the piston or reciprocating engine ruled the roost alone a few years ago, now there are rocket and Diesel engines, turbojets, ramjets, propjets, steam turbines and electric power to choose from. Even atomic energy is being vigorously explored as a possibility. And a group of French scientists hope to convert cosmic rays into propulsion forces.

Combining two new ideas, Britain's jet-propelled flying wing is the forerunner of a proposed 88-ton transport



Rocket power's possibilities are being explored in the 600-mile-an-hour Tiamat. The National Advisory Committee for Aeronautics says it's the first guided missile actually to fly through predetermined maneuvers

Major conventional engine builders, alert to potential successors, have earmarked huge sums for research in these new fields.

For the first time in history the aircraft designer is attempting to catch up with the power plant designer. There already exist engines for which there are no suitable planes. Speeds have hurtled, within the memory of living men, from 12 miles an hour to more than 10 miles a minute. And speed is aviation's greatest advantage.

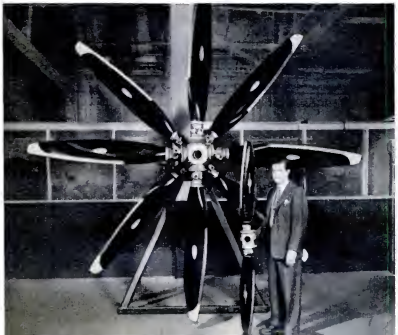
If you're impatiently waiting to fly in one of these new planes, though, let's remember that engineers are predicting it'll be 1949 or 1950 before they're in commercial operation. To design and build a plane with aerodynamic features tailored to a new kind of power will probably take at least two years, with another year to get it into service. As a realistic example, the U. S. had to rely during the war entirely on planes designed before Pearl Harbor, and that was under the prodding of a national urgency program.

One of the biggest advances thus far has been experimentally modifying a heavy British bomber, the Lancaster, with two conventional engines inboard and two turbojet units outboard. Using only the jets. 30 minutes was pared from the best round-trip transport time between London and Paris. One way was flown in 49 minutes.

But this trial by no means indicates a readiness to meet the stiff schedule, safety and operating economy demands of the regular air lines. The British have also built the first jet-propelled flying wing aircraft.

Sketches by the noted British artist, G. H. Davis, of major European ramjet developments follow on the next two pages. This article **continues on page 138**

Keeping pace with power plants, two four-bladed contrarotating propellers (left below) provide speedy engines with a better "bite" into the thin upper air. Right, wind tunnel testing 13-foot blades for an air liner



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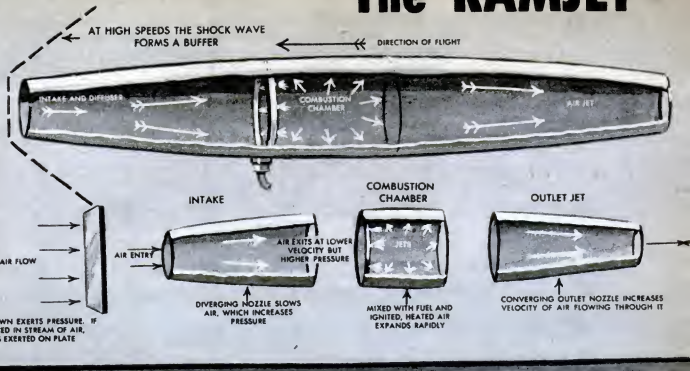
The RAMJET—



FLYING DUCK SUPERSONIC RAMJET

COMBUSTION CHAMBER

FOR INITIAL THRUST AT TAKEOFF RAMJET USES JETTISONABLE ROCKETS

ROCKET BATTERY

LOW ASPECT RATIO WINGS

PILOT IN JETTISONABLE CABIN

FLYING-WING TYPE—BRITISH

RAMJET TO CARRY RECORDING INSTRUMENTS, CONTROLLED BY RADAR OR GYROSCOPE—RUSSIAN

PILOT

FUEL

RAMJET

CLIMBING PERFORMANCE OF RAMJET FAR INFERIOR TO ROCKETS—VARIOUS TYPES OF BOOSTERS UNDERGOING TRIAL

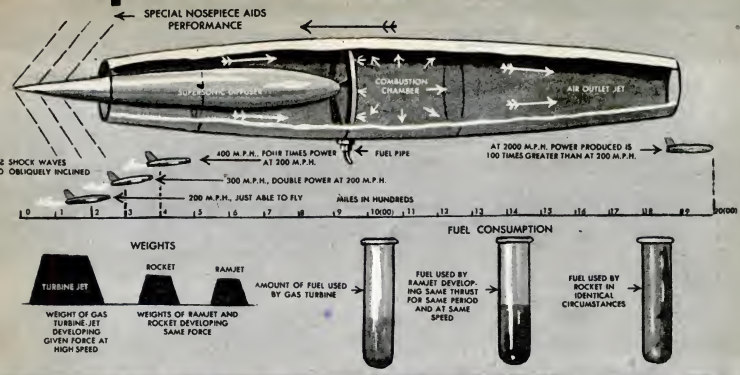
JETTISONABLE ROCKET BOOSTER

GUNS

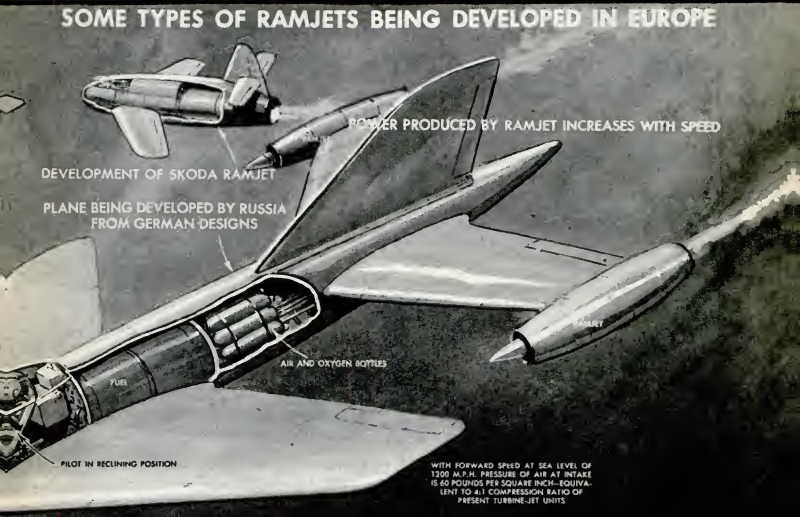
RETRACTED SKID

G. H. DAVIS

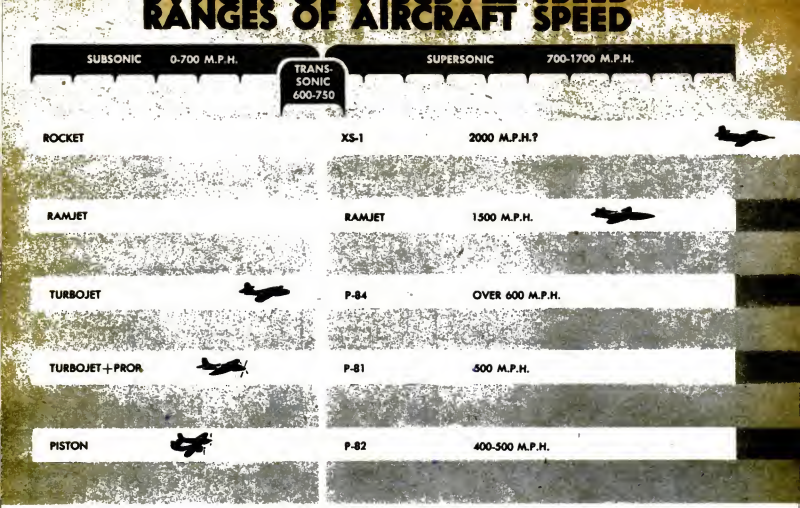
Simplest of Prime Movers



SOME TYPES OF RAMJETS BEING DEVELOPED IN EUROPE



Russia, Britain and the United States have pushed well ahead in developing the ramjet as a possible man-carrying, or at least guided. missile. Known in Europe as athodyd (aero-thermo-dynamic-duct), it is simply a tube into which air is forced by the speed that the tube is driven through the atmosphere. This air is mixed with a fine spray of fuel and fired, issuing from the narrowed tail as a tremendously powerful jet. Unlike gas turbines. in which a compressor raises the pressure of air supplied to the combustion chamber, the ramjet relies on its own speed for this and has no moving parts. Its chief drawbacks at present are excessive fuel consumption, the need for supplementary launching power and a mediocre rate of climb. Now rockets are being used for launchers and as a booster until the ramjet first begins operating at a speed of at least 200 m.p.h. From there on to supersonic speeds its efficiency increases sharply, limited only by combustion factors



the AW-52, and put it through test paces. Weighing 14½ tons, it represents five years' intensive work by designers and engineers.

Another test arousing comment has been the Army Air Forces' flights with a rocket-powered fighter, the XS-1, "held down" initially to speeds around 550 miles an hour. This, too, has been conducted under selected, laboratorylike circumstances, rather than normal conditions. Our knowledge of the plane's supersonic capabilities is still painfully limited.

The most popular prediction is that each of the major power plant forms—piston engine, turbine driving a propeller, and turbine-jet—may dominate an exclusive field, with the more versatile turbine-prop combination overlapping the other two.

At altitudes around 25,000 feet and speeds bordering 300 miles an hour, the conventional piston engine may continue as the most efficient form; above that, up to 500 miles an hour and approximately 45,000 feet, the turbine-prop is likely to be the choice; and exceeding that in speed and altitude the propellerless jets are conceded to be the probable answer.

A British authority, speaking of all aircraft, estimated that the piston engine will remain the leader for five years, the various forms of turbine power would be predominant during the following five-year span, and the third period might see the practical end of the piston engine. Military leaders, placing the premium on speed, are already overwhelmingly committed to jet programs in the fighter class.

Let's take a look at the various power plant forms and what they have to offer.

Foremost since the Wrights' pioneering flights, the highly dependable piston engine has developed to an astonishing efficiency. Within a quarter of a century it boomed from 200 horsepower to the 36-cylinder 5000-horsepower giant recently unveiled by Lycoming and the AAF.

Engine weight per horsepower dropped from 5½ pounds to less than a pound, useful loads went from one ton to well over 30 tons, and speeds rose from 150 to 500 miles. Range has stretched from a few hundred to more than 11,000 miles.

Engineering changes went on constantly. For example, the new 5000-horsepower engine has a two-speed gear as one of its most distinctive features. "Low" is used for take-offs, climb and landings, and "high," consuming an estimated eighth as much gasoline, for cruising.

But while the piston engine grew into a complicated and more perfect instrument with some 50,000 parts, propeller efficiency dropped sharply as speeds moved towards 400 and 500 miles an hour. Even with the development of fuel and water injection, cooling fans, extension shafts, superchargers that permit engines to "breathe" and function efficiently at extreme altitudes, and many other devices to boost power utilization, the piston engine has apparent-

ly hit a ceiling at approximately 500 miles an hour.

This all happened while equally remarkable advances were being made in propellers. From stubby, crude wooden models we've progressed to hollow steel electric propellers 19 feet in diameter, with blade angle controlled in flight to meet varying flight conditions. They can be electrically de-iced either internally or externally.

Another improvement was dual rotation, where a pair of three or more bladed propellers, contrarotating, supply the increased airfoil surface needed in high, thin air. Two manufacturers have gone on to experiment with eight-bladed dual rotation spinners. A comparatively new feature, reverse thrust, cuts long landing runs and allows even heavy transports to "back" into ramp positions.

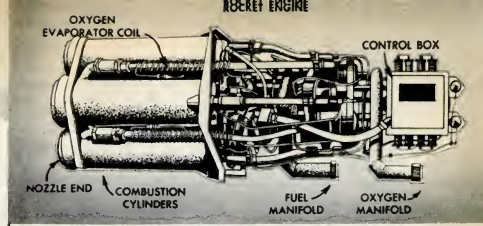
Within the piston field are two camps, air-cooled and liquid-cooled, each claiming superlative performance. One of the believers in liquid cooling broadly explains their essential differences this way: "The liquid-cooled engine, properly installed, has a circulating system like the constant-temperature blood circulation of birds and warm-blooded animals. The air-cooled engine is much more akin to insects, which lack a circulating system. The much greater capacity of birds and warm-blooded animals to withstand wide variations of climate is well known."

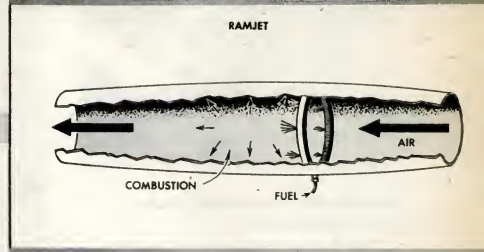
Air-cooled engines have been far more popular in American planes, especially transports and bombers, with Pratt & Whitney and Curtiss-Wright the acknowledged leaders. The liquid-cooled school, however, scored a notable triumph when an Allison-engined P-39 won the grueling 1946 Thompson Trophy Race, premiere U. S. speed course event.

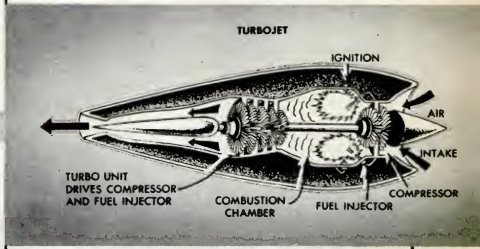
Foremost challenger of complete piston supremacy is jet propulsion. Though the principle was illustrated by Hero of Alexandria in 130 B. C., it wasn't until 1940 that an Italian made the first jet-powered flight. Most credit for pioneer development, however, properly belongs to Britain's Air Commodore Frank F. Whittle. His original patent was granted in 1930.

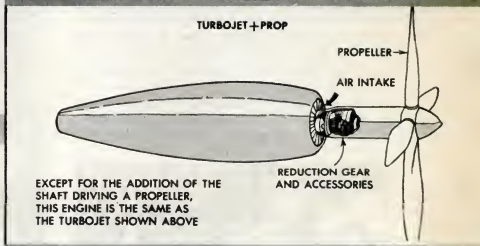
One of jet's outstanding virtues

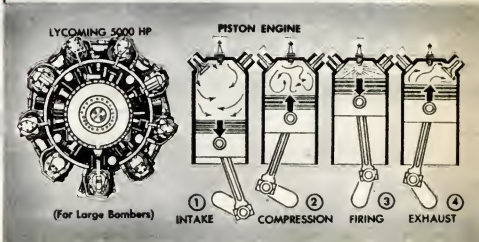
(Continued to page 268)









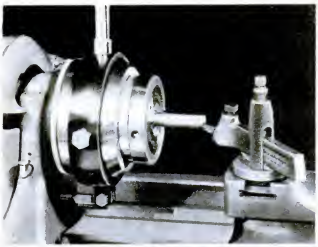


Push-Button Telephone Dialer Calls 50 Numbers

Telephone numbers are dialed with one push of a button on an automatic dialing box designed for the busy executive or businessman. Selection of any of 50 numbers is made by moving a small blade along the top of the box until a pointer indicates the name of the person to be called. Pushing a button at the bottom causes a number to be dialed automatically by a rotary shaft fitted with tooth disks hidden inside the box. The device does not interfere with finger dialing other numbers.

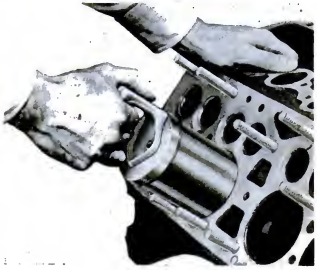
Tool Grips Steel or Soft Plastic

Designed for fast production work, a new-type collet chuck has selective adjustment for pressure that assures a firm grip for tough steel and a solid but gentle hold for thin tubing and relatively soft plastics. Another feature is that work can be changed without stopping the lathe. The collet, which is lever-operated, has capacity for diameters up to one inch and provides a steady hold through its full length to compensate for any irregularities in the material being machined.



Insert Cylinder Sleeve in 30 Seconds

Without removing the engine, cylinder sleeves can be inserted in an automobile engine in 30 seconds with a new type of tool. Assuring perfect alignment, the tool makes it impossible to drive the new sleeve in crooked. The tool is precision ground to exact size and fits over the sleeve so that

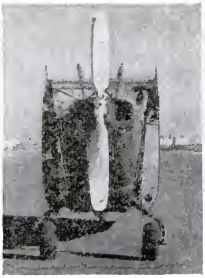


the sleeve will not collapse or otherwise become damaged during insertion. The weight of the device drives the sleeve in.

Ice Mask Protects Actors' Makeup

Five-minute applications of an ice mask prevent perspiration from spoiling makeup on faces of stage and screen actors performing under hot lights. The mask, consisting of plastic covered ice cubes to avoid dripping, is applied just before the actor is to appear under the lights.

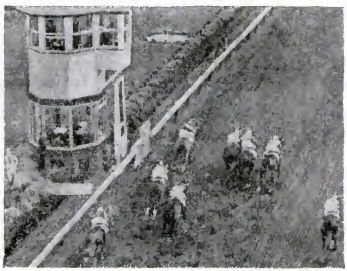
Plane With Folding Wings Can Be Towed Like a Glider



Exceptionally large wing area enables the Army Air Forces' first all-metal liaison plane to take off or land within 230 feet and be towed in the air like a glider without removing the propeller. The wings fold back and the landing gear is adjustable, with a 92-inch tread for takeoff and landing and 61 inches for ground hauling and towing. Built by Consolidated-Vultee and designated L-13 by the AAF, it is 31 feet nine inches long, eight feet five inches high and spans nearly 40½ feet. Its empty weight is just under a ton and its useful load about a half ton. Cruising speed is 92 miles an hour, range 368 miles and lowest landing speed slightly above 43 miles an hour. Although normally intended for three persons, it can accommodate six. The right-hand controls are removable to convert the plane into an ambulance for two patients besides the pilot and an attendant.

Helicopter Movie of Horse Race Helps Check Final Results

Racing equipment at the Salem, N. H., track includes a helicopter that carries the steward of the race and a motion picture cameraman to register the results on film. The helicopter hovers above the horses as they circle the track, which gives the flying steward an excellent view of the entire race and any fouls that might be committed. Race results and disputed fouls can be checked with the movie film.

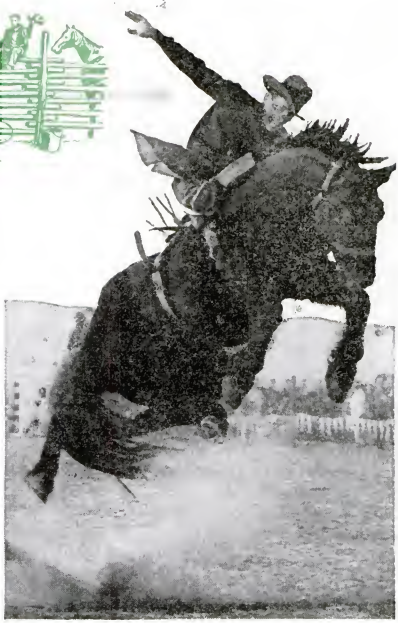


Scenery and horses are the lures at all dude ranches. Below, a dude's first riding lesson is in saddle cinched to a corral fence

BIG BUSINESS IN DUDES

DEEP in their hearts tens of thousands of people hanker for the old days of the West when a man could fork a horse and ride all day long without seeing a fence.

The fact is, the coyotes still howl in the western hills and, if you wish to try it, there are dude ranches where it's still possible to get up before dawn, saddle a horse and spend the day with cowhands poking through the brush for stray stock. You can eat beans at the chuck wagon and spend the night in a blanket roll. With a pack animal carrying food, you can avoid civilization for weeks while following old trails, dry panning for gold in lonely gulches and fishing untouched streams. Or, if all that is too active, you can stick close to ranch headquarters and do nothing more exhausting than watch the neighborhood rodeos.

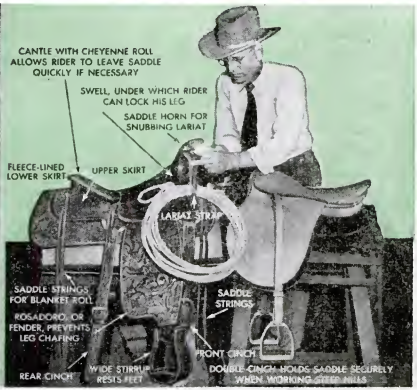


There are hundreds of western cattle ranches that raise beef and, on the side, take in paying guests. You can help with the chores, ride the range as soon as you get toughened to a saddle, or drift off into the hills on exploration trips. Within reason you may do as you please.

Cattle ranching hasn't changed much with the years. The ranch owner today may have a landing strip adjacent to headquarters and he may truck cattle to the shipping point but the horse is still primary transportation on the ranch itself. He still brands calves and holds roundups just as in the past.

Dude ranches range all the way from bona fide cattle ranches that accept a few vacationists at a time to the guest ranches whose chief business is providing entertainment. Accommodations

Stay with 'im, boy! Bronc riding's not for dudes but they see lots of it at ranch rodeos. New to West are aluminum spurs and bits and Nylon lariats, lower left. Photo at right compares western saddle (left) with eastern



Rodeo star Monty Montana skips through lariat atop trained horse

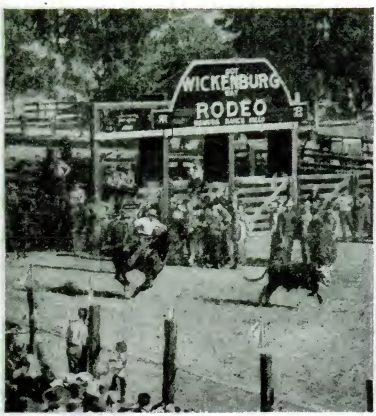
are more luxurious at guest ranches and include facilities for such sports as swimming, tennis and badminton. Rates range from $5 to $50 per day, board and horses included.

Dude ranching started back in the last century when a few easterners talked some cattlemen into allowing them to make extended visits as paying guests. These dudes sometimes helped in ranch work and were a source of extra income.

When the visitors went back home they told stories of long days in the saddle, of brushes with wild animals, and hinted at glamorous parts played in capturing bands of rustlers. Soon more and more people wanted to share such experiences. The demand became so steady that a number of cow outfits built guest houses and announced that they were ready to accept boarders. The dudes came back year after year. Some of them stayed on and helped to build up the country. During bad years the extra income from vacationists was all that kept some ranches from going broke.

Today you will find dude ranches of every description in scenic parts of the West. Reno and Las Vegas are mailing ad-

The chuck wagon brings chow to steak fry (left). At right, dudes watch calf-roping contest at an Arizona rodeo



dresses for dozens. They abound on both sides of the Rockies in Colorado; they are scattered through Utah and Idaho, and there are dozens more in the coastal states.

The dudes pack up and leave the central and northern ranching states by the time autumn begins. That's when the southern ranches, from Fort Worth to Palm Springs, open. Dry, sparkling days and blue skies characterize the southwestern winter and the season extends from November until April.

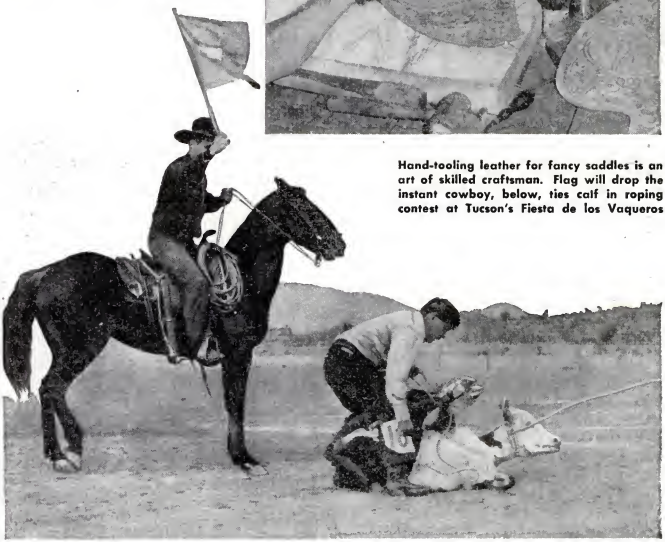
By Thanksgiving time the ranches around Phoenix and Wickenburg are filled. The more than 50 ranches within a 100-mile radius of Tucson become active. Horseback parties spend long days in the saddle exploring the dry desert plains and hills or riding through the timber of the higher ranges. The region is hot in summer but has perfect vacation weather in winter.

You can even go dude ranching in New York state, in many

Phoenix Chamber of Commerce photo

Class of eastern girl dudes gets lessons in the art of throwing a lariat loop. The target for their efforts is a stuffed calf

Hand-tooling leather for fancy saddles is an art of skilled craftsman. Flag will drop the instant cowboy, below, ties calf in roping contest at Tucson's Fiesta de los Vaqueros



Old stage coach, above, hauls dudes at Las Vegas. Desert cools quickly at night and a campfire warms moonlight riding party

The automobile hasn't replaced the horse on dude ranches but bulldogging steers from a running board thrills the visitors

Phoenix Chamber of Commerce photo

parts of New England and down the seaboard to the Carolinas these days. Many resorts have added western atmosphere by building corrals and acquiring riding stock, western saddles and hired hands who know how to wrangle dudes. Trail riding on good horses is the chief sport at all of them.

Dudes and westerners alike dress up in fancy togs on holidays. Western boots, 10-gallon hats, gaudy colored shirts and tight frontier pants are typical. Rough and ready clothes are best for ordinary ranch life. An old wide-brimmed hat, cotton shirt and a pair of the blue pants known as levis make a good outfit. Leather jackets are comfortable after dark in most parts of the West all summer long.

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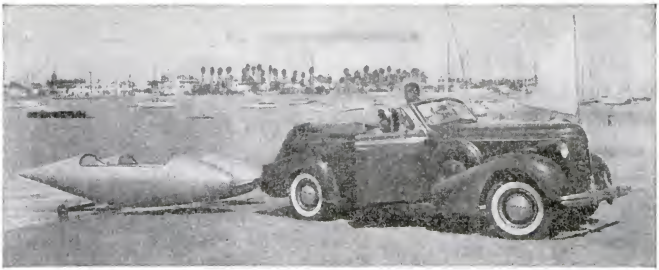
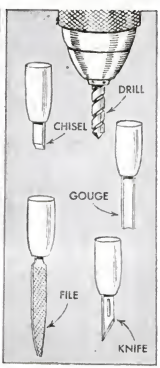


Gas Tanks Are Hulls For Speedy Boat

Surplus plywood auxiliary gasoline tanks for light bombers serve as twin hulls for a speedy outboard catamaran built by Alvin D. Bloom, 22-year-old ex-Marine, at Long Beach, Calif. Weighing only 280 pounds (plus 30 pounds for the outboard motor), the 14-foot craft skims across the water at speeds up to 20 miles per hour. The catamaran rig is adaptable to centerboard and sail. Bloom hauls his boat on a trailer dolly which is made of steel tubing and weighs only 60 pounds. The 310-gallon tanks from which the boat was made are said to have cost $460 each during the war, but are now available at a much lower figure.

One Tool Does Nine Jobs to Aid Modelmaker in Precision Work



Interchangeable accessories on a tool for modelmakers perform nine different cutting jobs. By fitting different tools to the chuck the craftsman can notch, cut V-shapes, punch holes, chisel, drill, carve, file, saw or cut razor-thin.

More Frozen Food Lockers

There are now 8025 frozen food locker plants in the United States, 1561 more than a year ago, according to a survey conducted by the U. S. Department of Agriculture. The 8025 plants contain about 3,250,000 individual lockers and provide storage for approximately 1,250,000,000 pounds for about 2,500,000 families. Nearly three fourths of the locker patrons are farmers.

Ted Rowell pours sample of burbot-liver oil; it is eight times more potent than cod-liver oil

VITAMIN HARVEST

By Robert Page Lincoln

ALONG the Canadian border at Baudette, Minn., a new industry is being hailed as a medical find. The raw material for this industry is a lowly fish known as the burbot. Ted Rowell, founder of the industry, discovered the burbot yields a gold mine of vitamins in the form of liver oil.

Commercial fishermen, who ply their operations in Lake of the Woods border waters, long considered the burbot worthless. They have dumped untold thousands of these fish on the lake shores to rot.

Young Ted Rowell, a graduate of the University of Minnesota School of Pharmacy, was struck by this wastage of fish. Preliminary studies of the burbot revealed that its liver is unusually large; in fact, the liver accounts for about 10 percent of the weight of the fish. Knowing that in ages past the burbot was a relative of the salt-water cod, Rowell went to work to extract oil from burbot livers. He hoped its value as a vitamin provider would equal that of cod-liver oil.

His first experiments were conducted on a cookstove at home. That was in 1933. Two years later he had set up a small factory-laboratory. He estimated from tests that burbot-liver oil had a vitamin content four times more potent in vitamin A than the best cod-liver oil on the market. More recently investigations by the American Medical Association Council on Pharmacy and Chemistry, the high court of pharmaceutic research in this country, rated burbot-liver oil eight times more potent than cod-liver oil!

It was not until the onset of World War II that Ted Rowell's burbot oil product came to national attention. Importation of cod-liver oil from Norway, one of the greatest producers, became prohibitive when the price soared to nearly $145 a barrel. When Germany invaded Norway this supply was cut off. In the search for a substitute, Rowell's burbot-liver oil came into the limelight. It received the closest inspection by medical experts. Almost overnight the young scientist at Baudette found opportunity knocking at the door.

In 1940 Rowell handled a half million pounds of burbot in his laboratories and the over-all total now is about 5,000,000 pounds from Lake of the Woods alone. Thirty commercial fishing crews remove the fish from these waters. Burbot livers are also shipped to Rowell from as far east as the Great Lakes and from other regions.

"The question is often asked if sufficient burbot are available to keep this industry

Fresh-water cousin of the cod is the burbot which lurks in deep waters and is seldom seen by sportsmen. Its unusually large liver (below) has been found to be rich in vitamin A

going," says Rowell. "The truth is that although other supplies of fish have been tapped enormously all over their northern range, the burbot has never been hindered. The range of the burbot is from Labrador and the maritime provinces of Canada down to New England, New York, the Great Lakes and west to the upper Missouri, the Columbia River basin, Alaska and the entire arctic region. We have merely touched the outer fringes of supply."

What is the nature of this remarkable fish which few ever see and know so little about? Not so long ago in a north central town in Minnesota a dead burbot was found on a lake shore. It was displayed in a

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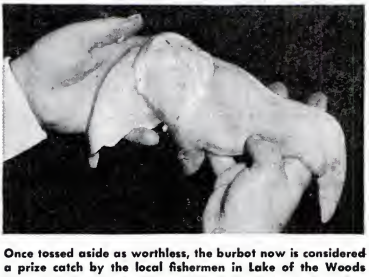


Once tossed aside as worthless, the burbot now is considered a prize catch by the local fishermen in Lake of the Woods

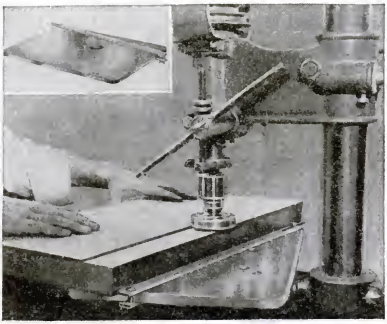
Sailplane Carries Jettisonable Water Ballast in the Wing

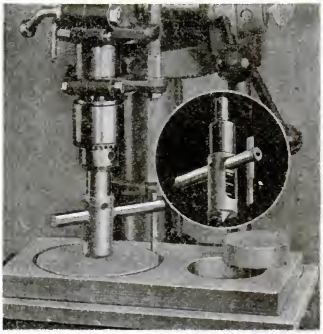
Schweizer Aircraft photo

Several hundred pounds of disposable water ballast in the wings will be a feature of a sailplane, now being built at Elmira, N. Y., to better the world's distance record of 465 miles. It can be jettisoned at will to enable the pilot to use lighter soaring conditions and makes possible cruising speeds of 80 miles an hour. Single-place, the sailplane will have an extremely thin 51-foot wing of aluminum alloy and a single-wheel landing gear, with a rubber-mounted skid forward of the wheel.

Auxiliary Drill-Press Table Helps in Routing or Shaping

For drill-press operations in wood, plastics or metal, an auxiliary drill-press table provides an enlarged and true working surface. Designed for use with cutting, drilling, grinding and shaping tools, the 13 by 18-inch table is cast of aluminum alloy. The cadmium-plated steel fence has a high-speed clamping arrangement for guiding and controlling the workpiece in planing, mortising, routing or other operations. The table comes equipped with irregular shaping pin, anchor bolts, fence and fence-clamp assembly.





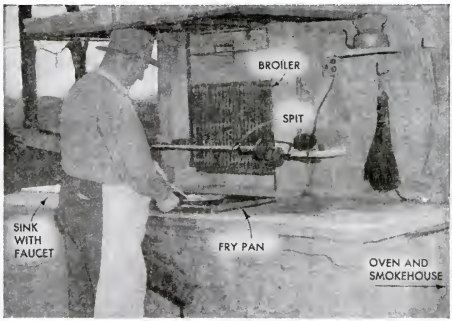
Circle Cutting Tool for Craftsmen Centers Itself Automatically

Drilling a pilot hole is unnecessary with a circle cutting tool utilizing a spring-tension cone center. The spring forces the cone tight against the exact center of the work and holds it tight on the table. If a craftsman desires, he can later drill any size center hole. If a solid disk is wanted, use of the tool leaves no hole to be plugged. The circle cutter can be mounted in a drill press or, with an adapter, on a bandsaw or jigsaw. It will cut diameters up to 14 inches in wood or plastic materials.

Information, including manufacturers' names, concerning products described in this issue may be obtained by writing Bureau of Information, Popular Mechanics, 200 E. Ontario St., Chicago 11, Ill.

Versatile Outdoor Range Is Complete With Running Water

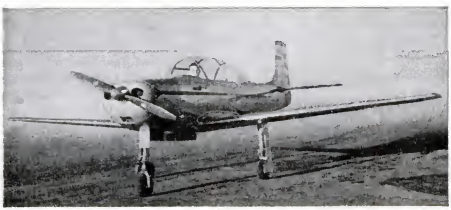
Food can be barbecued, roasted, baked, broiled, fried, boiled or smoked on a versatile range that Paul Reich, a Minnesota sportsman, designed and built in his own back yard. The range has running water and storage space for pots, pans and condiments. The barbecue spit is turned by a small motor.



Side-Door Delivery Speeds Service

Telephone - operated side-door delivery service speeds heavy or bulky items to customers of a Little Rock, Ark., department store who do not want to wait for regular delivery. After the purchase is made, the article is sent to the basement for wrapping. The customer drives to the side door of the store and calls over a direct telephone for his package. Basement employees then deliver the package to the customer's car, which is allowed three-minute parking for this purpose.

Tandem Two-Seat "Streak" Cruises at 150 Miles an Hour



Two occupants sit tandem fashion under the bubble canopy of the Streak, a new personal plane. Its cruising speed and range are estimated at 150 miles an hour and 700 miles, using an air-cooled Continental engine with direct fuel injection. The tricycle landing gear is retractable.

Gyrodyne Combines Features of Helicopter and Autogiro

First of a new class of rotary wing aircraft, the British Fairey FB-1 is moved forward by a propeller as well as forward, backward and sideways by a rotor. Called a gyrodyne, it differs from a helicopter, which is propellerless, and an autogiro, which gets lift but not movement from a rotor. The propeller is offset on a wing tip and also serves to counteract torque set up by the rotor. A prototype being built will be used mainly for research.

¶To the relief of hay fever sufferers in one New Jersey community, 95 percent of the ragweed was killed by spraying with 2,4-D, antiweed chemical.

LESS TOIL FOR TILLERS

Laborsaving machines point the way to an era when farmers will wear white shirts to work and sit at a master control board

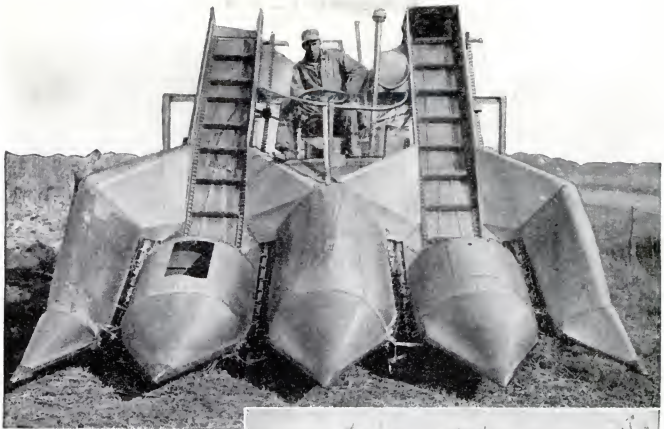
By Robert L. Crane

WHEN a farmer made a trip to town 40 years ago he hitched his team to a buggy or wagon and spent almost an entire day driving to the nearest town and back.

Today, thanks to the Wright brothers, many farmers are flying to comparatively faraway towns and cities to do their shopping. This transition from clumsy horse-drawn buggies to the sleek light planes seen parked in many a pasture lot is typical of many recent changes on U. S. farms.

These changes — improvements wrought by a mechanical age — are timesavers, laborsavers, moneysavers, and sometimes lifesavers. Some of the laborsaving machines are so practical and familiar that they seem almost commonplace. Mechanical hay load-

Antifrost machine for truck garden or orchard warms an acre by infrared heat waves



Four-row corn picker is powered by combine motor and propelled by tractor. It husks more corn in 20 minutes than a man can pick in an entire day

ers and rakes, corn huskers, hydraulically operated manure loaders, power saws and sprayers are in this category.

On the other hand, there are some strange-looking machines which perform some highly unusual tasks. Such is the antifrost machine developed at the Michigan State College of Agriculture. Mounted on two wheels, the machine looks like a large transformer. It contains an oil-burning heater which sends out infrared heat rays to plants and soil in an acre of ground. The heat is radiated from big aluminum reflectors and the unit requires a minimum of maintenance.

Another machine, which is as odd looking as it is practical, is a tractor-powered conveyor used by Long Island potato growers to move heavy water pipes across a field. The conveyor consists of an endless chain mounted on a tubular frame to which are attached at one-foot intervals 3 by 6-inch boards at right angles to hold the pipes. The frame sets on a trailer pulled by a tractor. Workers disconnect the pipes as the conveyor moves down the field and place them on the chain to be deposited on the other side of the conveyor.

Of all the farm timesavers, the airplane is probably the most dramatic—even if not the most practical machine. The light plane, which is a sportsman's luxury item in the city, can be put to earning its gas and oil on the farm. One Oklahoma farmer counts his cattle, scatters salt to livestock and checks soil erosion from his plane. A rancher in New Mexico uses his hedgehopper to shoot coyotes. Sowing oats and grass seed, spreading fertilizer, inspecting crops and fences are a few of the tasks a flying farmer in Illinois accomplishes from the air. One county farm adviser makes all his calls by plane. Other common uses of small planes on farms are for spraying orchards and field crops, for traveling long distances to get repair parts, or for marketing such perishables as strawberries.

The farmer of yesterday and his numer-

Pickup baler saves lifting the heavy rolls of hay. Left, power saw cuts heavy underbrush and saplings

ous hired men used to spend an entire week filling the silo each fall. Often the neighbors were called in to assist. First, a day or two was spent cutting the green corn by hand with a long knife and laying it in bunches. Each heavy pile of stalks was loaded on a wagon, hauled to the silo, fed into the ensilage cutter and blown into the silo. Later on, as the ensilage was fed, it was necessary for someone to climb into the silo and throw the feed down every morning and evening.

Today, corn to be ensiled is cut in the field by a mechanical cutter and loaded into a self-unloading wagon following behind. The corn in the wagon is unloaded with an electrical motor attachment and blown into the silo. Unloading from the silo is accomplished with an electrically driven unit which revolves, picks up the silage and tosses it into a chute where it falls into a cart below. The entire operation — from field to feed bin—is completed without the farmer once lifting the heavy green cornstalks or the ensilage. It saves many manhours and backaches.

The "making" or harvesting of hay has been a favorite subject with song writers and artists for years. Mechanical hay loaders and rakes are taking the romance as well as the drudgery out of this task. Not many years ago the pickup baler was hailed as a remarkable laborsaver. Alert-minded farmers soon realized that considerable lifting of bales could be eliminated by hooking a wagon directly behind the baler and loading it as the bales were delivered. The mobile baler of today is a big improvement

Peacetime job for jeep is powering threshing machine

over the old stationary baler that required a crew of half a dozen men.

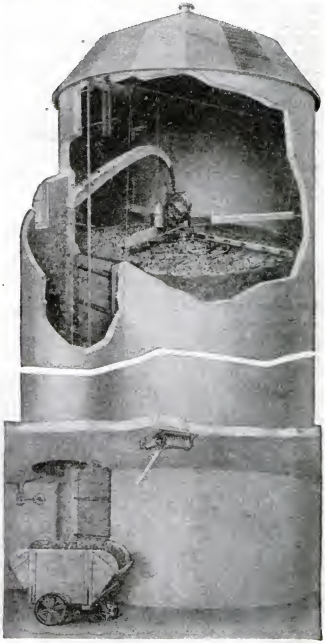
Another haying innovation known as the "chopper" picks up either green or dry hay from the windrow, chops it and delivers it to the wagon. The hay is blown into the haymow. Green hay can be cured by drying units installed in the barn loft.

One of the most welcome modern labor-saving devices on the farm is the hydraulically operated manure loader, or scoop. The loader is converted easily to handle grain, gravel, sand or hay.

A single machine—the power saw— has revolutionized two laborious farm jobs. These are mowing fence rows and cutting firewood. For centuries, hedgerows have been cleared of light brush, weeds and rank growths of hay with a hand scythe. The power saw not only does this job quickly and efficiently, but will cut down a tree 30 inches in diameter and saw it into lengths of firewood. This saw can be operated all day on only three gallons of fuel.

This farmer uses his Aeronca to make business calls

An Illinois farmer fights the corn borer by spraying DDT from high-slung rig attached to a tractor. Below, rotating silo unloader chops frozen ensilage



Tractor-powered conveyor saves manpower by moving water pipes 70 feet on irrigated Long Island potato farm

One of the most time-consuming and therefore expensive operations on the farm is the preparation of soil for planting. This has always been a triple operation: plowing, disking and harrowing. Recently, power machines have been developed which crumble and pulverize the soil in a single operation. This is done by hooks which rotate rapidly, breaking the soil into fine particles. If these machines prove successful they may revolutionize the manufacture of American farm machinery.

Many farmers have not learned to utilize their tractors to the fullest extent. Posthole diggers, wood saws and transport boxes are some of the important attachments often overlooked. Dirt scoops can be used to great advantage in digging ponds and ditches or for cleaning out old ones. They are handy also for moving sand, bricks or other building materials. Hydraulically operated transport boxes can be attached to the rear of tractors for hauling a few bushels of corn, several bags of grain, cans of water or other heavy items.

Another mechanical device that is stepping up efficiency and income on the farm is the power sprayer. Many spray units are powered by compressors operated by either electric or gasoline motors. Others derive their pressure for operation from the pistons of an idling automobile, truck or tractor motor. These sprayers apply paint about seven times faster than the average painter and distribute the coat evenly. Farmers also use the power sprayer in their orchards and for treating animals to guard against insect pests.

Some sprayers and various other machines mentioned in this article make use of electric motors which are a boon to farm work. Farmers use electricity to pump water, grind grain, turn separators and perform scores of other operations. All of these improvements are making farming one of the most attractive occupations in the U. S.

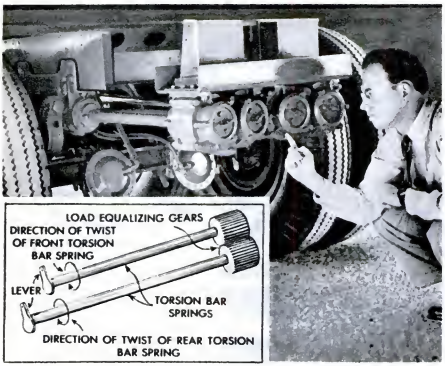
Handlebar controls on two-wheel tractor allow operator to walk to one side when plowing or cultivating

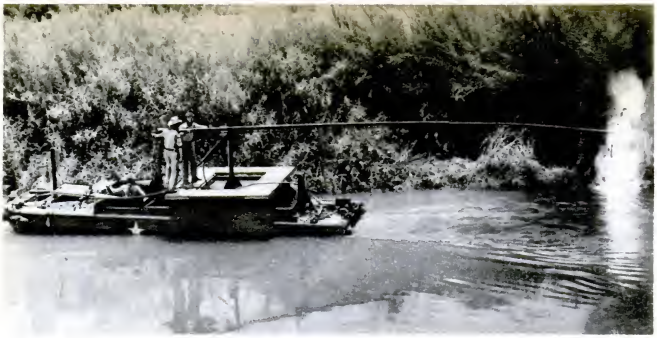
"Duck" Fitted With Echo Instruments Aids Shallow Water Surveys

Shallow water surveys of the Lake Michigan shore line are made by U. S. Engineers aboard a converted Army "duck" equipped with special sounding instruments. The eight-ton amphibious truck has been found ideal for beach survey work, requiring no dock facilities and climbing up the beach at almost any spot selected. A Navy echo sounding instrument has been fitted inside the steel hull. Engineers send supersonic waves through the duck's thin skin to bounce off the lake bottom and back to the instrument. A measure of the time interval between sending the impulse and receiving the echo tells the engineers the depth of the water. Another instrument, a self-tripping grapple, is thrown overboard periodically to obtain a sample of the bottom soil.

Gravity Suspension System Replacing Springs Saves Trailer Tires

Trailer tire mileages are increased by a gravity suspension system which replaces conventional springs on the tandem rear wheels of a trailer. Gravity suspension allows the tandem axles to track themselves around corners, thus reducing tire scuffing. One semitrailer, so equipped and carrying loads averaging 36,000 pounds, has traveled 220,000 miles on one set of tires without need of recapping or repairs. The system uses torsion bars instead of springs. The body of the trailer is attached to its axles by swivel-type shackle levers. The position of these determines the amount of twist imposed on the torsion bars by the weight of cargo or road shocks. The bars are connected at the forward ends by meshed gear wheels which serve as torque equalizers. The system adjusts the center of gravity so that the trailer leans in on curves. This reduces roll-over hazards. It also gives increased stability on all kinds of ground.

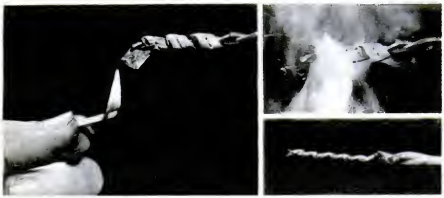




Flame Throwers Burn Weeds

Flame throwers developed during the war are being used by the U. S. Bureau of Reclamation to burn weeds off irrigation projects and other public works. The flame throwers are mounted on trucks, amphibian tractors, ducks and other war vehicles that can navigate rough roads, swamps and canals. When large vehicles cannot reach the weeded areas, operators fight the weed war on foot with small flame throwers. If burning is impracticable, war developed chemicals are sprayed on the weeds.

Self-Soldering Tape Is Ignited With Ordinary Match to Connect Two Wires



With a length of self-soldering tape and an ordinary match, soldered connections between wires can be made without a soldering iron or torch. The tape is wrapped around the wires to be joined and ignited with a match. This generates enough heat to melt the solder.

OPENING OYSTERS is no longer a struggle. By placing pressure on the center of the oyster, new shucking device opens the shell without damaging the oyster

JAPANESE GOLDFISH from Hirohito's own pool frolic in the plastic nose of a B-29, converted into Hollywood's oddest fish bowl by screen star Robert Cummings

SIT-DOWN FATIGUE is lessened by a pair of steps for the right and left side of a tractor. The steps allow the driver to change position and relax occasionally

SUPERCYCLE used in Italy puts the arms as well as the legs to work in bicycling. Pumping the handle bars works a chain drive applying power to the front wheel

STEEL HIDEAWAYS

By Jules B. Billard

THAT morning the usual combination failed to open the old safe in the local bank. Word spread quickly through the little Texas town and by the time a locksmith from nearby Fort Worth arrived, a sizable crowd had gathered.

Blue-denimed farmers and gallused storekeêpers watched while the expert talked briefly with the bank president, then went to work on the dial. Ten minutes of patient twirling and trying the handle, and the safe clicked open. From that moment on, you couldn't convince an individual for miles around that the stories about yeggs with supersensitive ears who could hear tumbler pins drop or whose sandpapered fingers could solve the trickiest combination weren't gospel truth.

Actually, that's far from the case. Tumblers don't drop—the right key or the right combination merely lines up the pins inside the lock so that none interferes with the lock's opening. And sandpapered fingers aren't any help in figuring out combinations—a good modern safe dial has as many as 1,000,000 possible groupings. It would take you nearly two years to try them all—provided you worked night and day at a rate of one combination every minute. The reason some crooks are able to open combination locks is because they know it's human nature for people to want their locks set with easily remembered combinations of numbers—10-20-30 or 2-4-6-8, for example.

The explanation of the Texas "miracle" is easy. When he talked to the locksmith

Set flush with the floor, a fire and burglar - resistant home safe is concealed by rug. Lid lifts automatically when unlocked

at the bank, the president told him the safe's combination. The expert, knowing that the safe was old, guessed rightly that one of the pins had become worn just enough so that it wouldn't line up properly when the correct numbers were dialed. After that it was merely a job of trying a few numbers to the right and left of the correct ones until, by a simple process of elimination, the worn pin had been located and an opening combination hit upon. The locksmith never could have done it if the bank president hadn't given him the old numbers to begin with.

However, there's no such thing as a burglarproof safe. Even the companies which manufacture safes will tell you that anything man can build, man can also destroy. But they will tell you that their product can successfully resist even the canniest safecracker under the conditions indicated by the chest's label.

Here's what a burglar-resistant chest has to go through, for example, in order to qualify for top classification under standards set by the Underwriters' Laboratories: attack by experts using sledges, chisels, drifts, rotary hacksaws, wedges, portable electric drills or any other commonly available tools; exposure to the cutting action of any commercially available oxygas burning or welding torch; and finally, use of nitroglycerin or other common explosive in any manner desired.

The laboratories' experts can try any or all of these methods for a solid hour. As an advantage over the yegg, they have the safe manufacturer's detailed drawings of the chest's construction and specifications

In Underwriters' Laboratories test, safe must protect contents in fire hotter than in a burning building

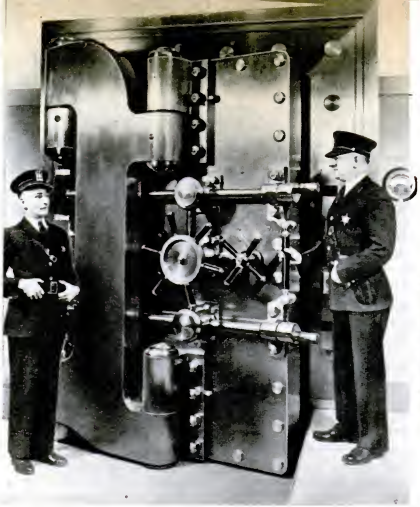
of the kind of steel or torch-resisting metal of which it is made.

That hour's attack by experts under favorable laboratory conditions is equal to a whole night's hacking by the most skilled cracksman. Little wonder the manufacturers feel their safes are plenty burglar-resistant.

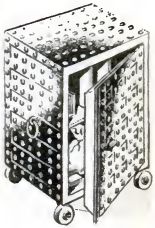
These modern chests are far better than the types Jesse James used to pry open with a pickax. Nowadays no safecracker can knock off the dial, punch out the spindle and release the lock. Not if it's a really good safe. Neither do you hear of an up-

How strong are bank vaults? In Hiroshima, after the atomic bomb exploded, American-made safes, below, were intact and functioning despite fire-blackened doors. Two Jap safes in the wrecked building were demolished

Mosler Safe Co. photo



A thin rubber band might prevent closing this huge door to a Chicago bank vault, but once it's locked a dozen safe crackers couldn't open it in a week



to-date chest being "blown" by a cracksman whose stock in trade is a few ounces of nitroglycerin poured into the crack around the door. The reason is that science is on the side of the safe manufacturers.

When Nevada Mike and the boys started grabbing their loot by breaking off dials and handles, safe manufacturers countered with relocking devices. These automatically—and effectively—lock the safe from inside if there is any tampering with the regular means of entry. And when Texas Slim and his followers started drilling their way through to the valuables inside, the answer was drillproof steel. Walls and door plates now are made from tough chrome and manganese alloys, too hard for even the best of points.

The nitroglycerin boys were beaten by building chest doors along the lines of a cannon breech, carefully machining door and jamb to tolerances of a few thousandths of an inch. A thin rubber band can keep a bank vault door from closing, and several instances have been recorded in which safes kept their contents dry despite days under water during floods. No chance here for the yegg to pour in enough "soup" to blow off the door.

Neatest accomplishment, however, in the safemaker's long battle against the night-stalking fraternity is the torch-resistant chest. It had to come because crooks were cutting a wide and profitable swath with oxyacetylene and oxyhydrogen torches. At first the yeggs had trouble—the 6000-degree heat from the flame turned the safe interior into an oven, charring paper and melting coin. Then one of them hit on the idea of burning a small hole through the top of the safe, filling the inside with water, and then leisurely cutting an arm-size hole while the water kept the temperature safely down.

Now, however, your valuables can be protected with a torch-resistant chest whose walls are made from an alloy of iron, copper and other elements. While this metal can be melted with a torch, it flows so rapidly that it seals itself the moment the torch is moved — something like butter when cut with a very hot knife. The knife slides through but the melted butter solidifying behind it closes the gap.

The safe manufacturers have the yeggs pretty well licked, but they aren't resting on their laurels. New and tougher wartime steels made for armor plate, tank parts and ordnance are going into new chests.

Science and the safe manufacturer have also joined forces against that other destroyer of valuables — flame. A burglar-resistant chest isn't much protection in a fire. Steel transmits heat, and it doesn't take long for a burning structure to build up temperatures inside a chest past the point at which paper chars. So fire-resistant safes have been developed.

They have to undergo grueling tests, too. The Underwriters' Laboratories and the Safe Manufacturers' National Association

(Continued to page 240)

Fog Beacons Guide Plane to Runway

Powerfully lighted approach corridors to runways are being tested to guide pilots down through fog, still one of aviation's greatest hazards. A system undergoing trials at the Landing Aids Experiment Station, Arcata, Calif., has 32 high-intensity lamps mounted on two rows of towers that funnel toward the runway. This light-fringed approach zone is 3000 feet long and the towers step down in height from 60 feet to five feet near the runway. Beam spread of the lamps for landings under an eighth of a mile visibility is 45 degrees horizontal and 30 degrees vertical. Values of lens systems and color filters are being determined in the tests. Used with electronic landing systems, the lights give pilots a visual ground check during the final letdown of a blind approach. At Arcata the system is being used with gasoline or fuel-oil burners that dissipate the fog. A recent innovation is the use of high-intensity sonic and supersonic systems that precipitate mist into rain, thus clearing the air.

Australia Battles Locusts From Air

Australia is winning another war this year—a war against locusts. The battles are being waged by bombers which spray insecticide over hatching grounds, by farmers armed with hand or power sprays, and by scientists from the Department of Agriculture. The result has been a 90 percent mortality rate for the locusts and a potential saving of millions of dollars worth of grain. The Australian Air Force is cooperating in the project, making use of techniques learned in spraying malarial infested beachheads during the war. A special spray for a gammexane and Diesel oil solution was devised where ordinary equipment produced too heavy droplets. The antilocust campaign is widely acclaimed by Australians who remember the plague of 1934-35 when the ravenous insects ate a path of ruin across the country.

Sketch shows experimental use of jato rockets (inset) for emergency stop of train

SAFER RAILROADS AHEAD

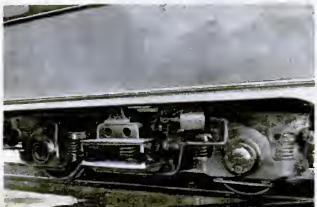
Red stop light on rear car warns following trains if engineer brakes or stops Union Pacific streamliner

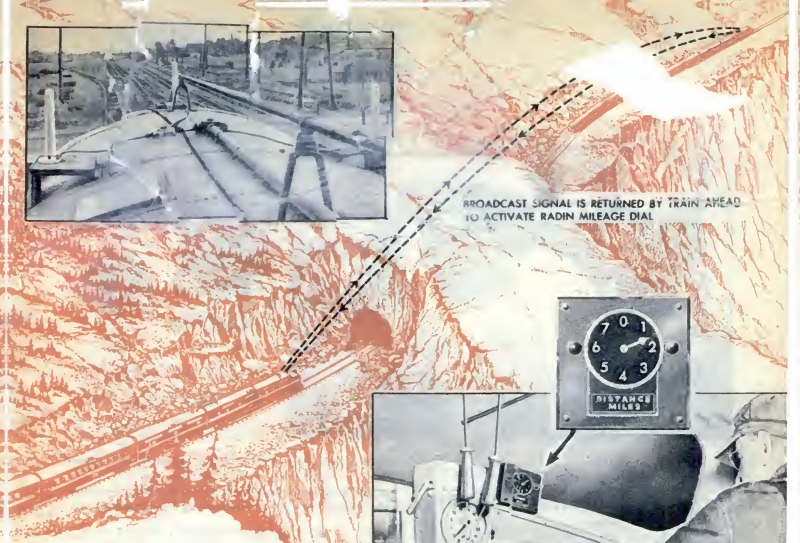
THE same rockets that enabled heavily loaded Navy planes to take off from carriers after short runs are undergoing experiments as emergency brakes for trains.

By reversing the thrust of the jato (jet-assisted take-off) rockets, engineers believe they can bring a train to a halt in one third the distance required by conventional air brakes. Pairs of rockets mounted on the locomotive and perhaps on cars would be ready for emergency use by the engineer.

This is one of several innovations being tried out by railroad safety engineers, utilizing war-developed techniques. Another

Air-filled rubber doughnut spring, right, may replace usual steel spring, left. It lessens bouncing and sidesway





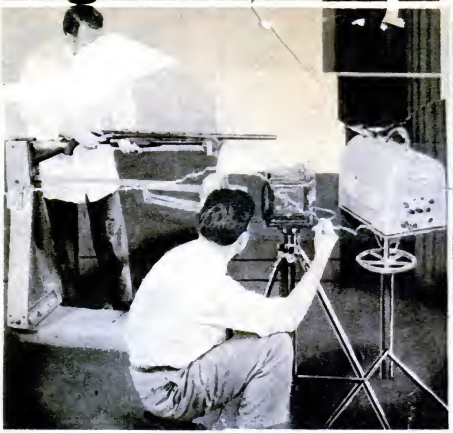
Bi-directional antenna on Rock Island car (top) handles radio signals to activate radin dial (right) showing distance in miles to train ahead

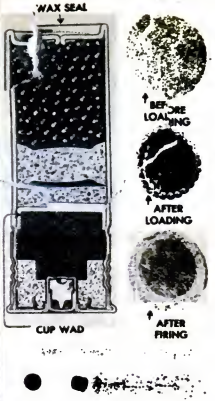
is the Rock Island's experimental radin, a high-frequency radio system which would warn the engineer of any train within eight miles of him.

Experts who engineered the jato rockets are working on the revolutionary rocket brake idea. Dr. Theodore von Karman of California Institute of Technology estimates that the distance needed to stop a 100-m.p.h. train can be reduced 1000 feet by rocket brakes delivering 500,000 pounds of thrust over a four-second period. Because such a sudden deceleration would slide passengers from their seats, researchers are working on rockets in which the thrust increases gradually.

The Rock Island's radin has been tested on the Golden State Limited and on Chicago suburban trains. Antennas on the locomotive send out a signal which is rebroadcast by similar equipment on any train within eight miles. When the rebroadcast signal is received, it activates a dial showing the gap in miles ahead or behind to the other train. This would be most practical for trains of two or three sections running a few minutes apart.

↓ Gear-driven diagonal bars move through opposite corners of Monroe noiseless crossing to form solid rail for moving train





High-speed photo directly above shows flying pellets from exploded shell, followed by filler wads. The expanding cup wad had dropped out of sight. To right of cutaway drawing are three views of expanding wad

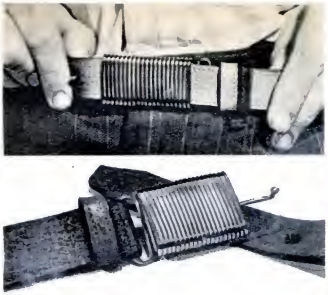
Wad in Shotgun Shell Expands To Seal Entire Force of Powder

Hunters can now obtain shotgun shells equipped with expanding cup wads which seal the entire force of powder behind the shot pellets. The wad, shaped like an umbrella, expands as it is forced up the barrel and seals the expanding powder gas behind it, like the leather washer in a pump. The nose of the new shell has a folding waxed crimp which eliminates the old style top wad that deflected pellets as they left the gun muzzle. The new shell's ability to concentrate the spray of pellets is expected to reduce the chances of crippling, but not killing, game birds.

Two Buses Converted Into Five-Room Home

Two obsolete buses converted into a five-room cottage solved the housing problem for a family in Dallas, Texas. The ancient motor coaches, minus engines, were placed on foundation blocks and boxed in with studding and siding. Roofing and porch were added, then a coat of paint.

You may wish to obtain additional information about the new products described each month in Popular Mechanics. If you want to know the name and address of the manufacturer or the distributor, just write to Bureau of Information, Popular Mechanics Magazine, 200 E. Ontario Street, Chicago 11, Ill. Your letter will be answered promptly



Belt Stretches as Waistline Grows

Hearty eaters and athletically inclined men and boys will find comfort in a belt which stretches with every movement of the body. The "give" is supplied by a chrome steel spring which serves as the buckle. The spring is rectangular, permitting the belt to pass through it and fasten on to the spring stud at the free end. Perforations holding the belt end in place are reinforced with rivets to prevent tearing.

Folding Pipe Fits a Man's Pocket

To make a smoking pipe more compact for carrying in a man's pocket, one manufacturer designed a shank that folds at two points. This also lessens chances of breaking the shank.

Rubber Coating for Egg Baskets

Rubber coating is added to the wire network of egg baskets to reduce breakage during collection from nests. The basket also is rustproof. Rubber covering is also applied to potato baskets to safeguard potatoes against bruising.

Midget Adding Machine Is Portable

Weighing less than five pounds, a midget adding machine for office or home can be carried easily. The machine is especially useful for taking inventory in crowded storerooms or in places where a calculator must be moved frequently. It is operated by stylus rather than push buttons. The stylus is inserted into the tooth of a wheel to the left of the number to be registered. A downward pull registers the number. Totals appear enlarged through a magnifier. The machine adds and subtracts and registers numbers in seven columns.

WHAT'S NEW *For Your Home*

A four-page "shopping section" dedicated to modern homemakers

DISHWASHER powered by ordinary water pressure instead of electric current uses eight high-powered jets to wash, dry and rinse complete service for four within five minutes

ROOM CONDITIONER consists of a fan with a detachable heating element. Fan is used alone in the summer, heater is clamped on in winter

PHONOGRAPH made in England can reproduce all the sounds audible to the human ear. Front louvers provide 180-degree sound dispersal

DRAWER PULL flush with surface pivots in to provide grip

CURTAIN RAISER eliminates dangerous reach from chair or ladder. Curtain rod is attached to sliding shaft which can be raised safely from floor level

WASHABLE WALL COVERING made of a plastic-treated fabric is available in a wide variety of patterns. Marks can be wiped off the stainproof surface

STOCKING HOLDER holds up to eight pairs for drying, folds against wall when not in use

BOTTLE HOLDER saves time for busy mothers by supporting standard baby bottles in any desired position

WHAT'S NEW *For Your Home*

Continued from preceding page

FLEXIBLE ARM holds the cord above ironing board, preventing it from kinking or becoming entangled with clothing

HOME DISPOSAL UNIT has tiny gas flame which eliminates refuse. Flame dries refuse which burns by itself

← **ASH TRAY** for pipe smokers features a bowl reamer, cork knocker and tool for packing tobacco in the bowl

BIRD CAGE made of Plexiglas is transparent from all angles, has a "bubble" dome, perches and swings

← **NUTCRACKER** works on off-center cam principle. Turning the handle cracks shell against side of the bowl

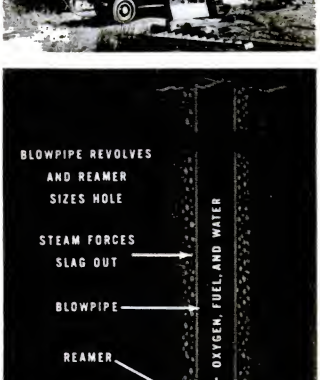
↑ **ELECTRIC HAIRBRUSH** with revolving bristles gives scalp quick massage

↓ **SINK STOPPER** fits flush with the drain, can't be dislodged accidentally

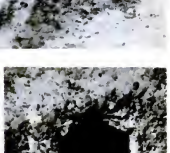
ELECTRIC BED WARMER is spread just beneath the bottom sheet, bathes the sleeper in a comfortable warmth that rises from below

POTATO CUTTER delivers shoestring potatoes in a continuous spiral ribbon about ¼ inch square. Onions and other vegetables also can be cut on the machine

Revolving Blowtorch Drills Holes in Iron Ore for Blasting Charges



Above left, experimental rig is set up for a fusion-piercing test. Left, diagram shows how an intense flame melts hole through rock. Above, rig expels slag during test. Right, six-inch blast hole was drilled 30 feet by fusion piercing



Vertical holes for blast charges are drilled in iron ore 10 times faster with a revolving blowtorch. Called fusion piercing, the method has been tested on hard, low-grade iron ore. A 4000-degree Fahrenheit flame, produced by burning oxygen and fuel in a special blowpipe, is directed against the surface to be drilled, melting some of the rock and flaking off the remainder. The pressure of burning gases forces the molten material past a water spray, and steam aids in forcing the material out of the hole. In field tests, six-inch-diameter holes were fusion pierced at 10 feet per hour. An average of one foot per hour was drilled by former methods.

Indicator Detects One Part Carbon Monoxide in 500,000,000 Parts of Air

Poisonous carbon monoxide fumes can be detected in extremely minute quantities with a chemical indicator 100 times more sensitive than any previously known. Developed by the National Bureau of Standards, the indicator consists of a sealed glass tube about five inches long and the diameter of a lead pencil. To make a test, the end of the tube is broken off and the yellow indicating material inside is exposed to air. If carbon monoxide is present the gelatinous indicating chemical turns a blue-green color. The indicator can detect one part of carbon monoxide in 500,000,000 parts of air. Among its uses are the examination of air in and around buses, automobiles, garages, furnaces, industrial plants and transport planes.

¶Cashew nut shells are made into "friction fortifiers" for brake linings by a New Jersey company.

Glass Prism Weighing 300 Pounds Ground for Mexican Observatory

Weighing more than 300 pounds and measuring 27½ inches in diameter, the largest glass prism ever ground was completed recently for an observatory in Puebla, Mexico. It will be used as auxiliary equipment in the world's largest Schmidt-type telescope to photograph stars 100,000 times fainter than the faintest star visible to the naked eye. It took the Perkin-Elmer Corporation six months to grind and polish the prism, whose dimensions check to an accuracy of three millionths of an inch.

Flat Safety Step Fits Ladder Rung

Foot comfort for painters, fruit pickers and others who use ladders for long periods is provided by a flat safety step which fits over the rungs. Adjustable steel brackets hold the platform securely.

Plastic Glue Cements Duralumin

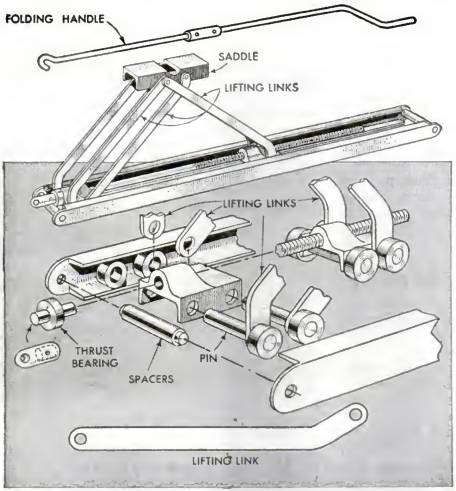
Gluing metal aircraft parts together is a possibility now being investigated by research engineers. If it proves a successful substitute for riveting, this technique will reduce surface drag of wings and fuselages. The glue—a new plastic adhesive—is extremely strong. In one series of tests conducted by the American Society of Testing Materials, the glue was used to cement together two pieces of 1/16-inch duralumin. Under bending stresses, the glue was stronger than the metal itself.

Instruments Chart Hurricanes Through Earth Tremors

Seismographs, the instruments that record earthquakes, are being used by the Navy in a new method of charting hurricanes. The hurricanes produce vibrations which are transferred through the water to the floor of the ocean and then through the ground to seismographs in the area. The earth tremors are recorded on a roll of sensitized paper by a pinpoint light through a slit in the seismograph. The charts show in graph form the severity of the hurricane tremors that shake the earth.

"Hospital" in a Suitcase Fits Car Trunk or Plane

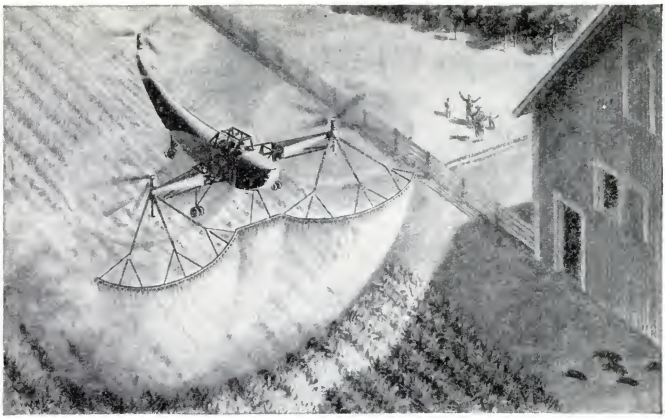
Ample medical supplies for most emergencies are contained in a first-aid cabinet which fits in the trunk of a car. It was designed for ambulances and crash wagons and as a "portable hospital" for quick transportation to mining and construction accidents or similar disasters. Inside the cabinet, which can be carried like a suitcase, are 15 three-ounce bottles of medicine mounted securely on an elastic base to prevent breakage. Also accessible when the unit is opened are a cotton holder, adhesive tape on a roll, jars of ointment, a supply of splints, hypodermics and thermometers, an alcohol lamp for sterilization and a flashlight holder for night work. The unit can be carried in a light plane and mounted on a tripod at the scene of an accident.



"Tipless" Auto Jack Safe on Hills

Any danger of your car or trailer rolling, even when changing tires on rough ground or a steep incline, is eliminated with a "tipless" auto jack. Base of the jack is 26 inches long. It is 4½ inches wide and in retracted position is only 2½ inches high. Maximum lifting height is 13 inches. The lifting saddle is mounted on four lifting arms. Lower ends of the lifting arms are mounted on rollers in the base to enable them to move slightly with the car as it is lifted. A folding handle allows operation from the side of the car.

¶Four-room houses are being built in Britain of concrete from waste of the china-clay industry.

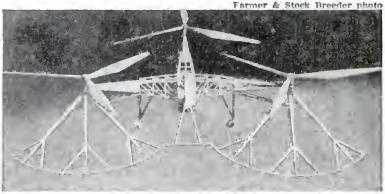


Helicopter Lays Mist Of Insecticide on Crop

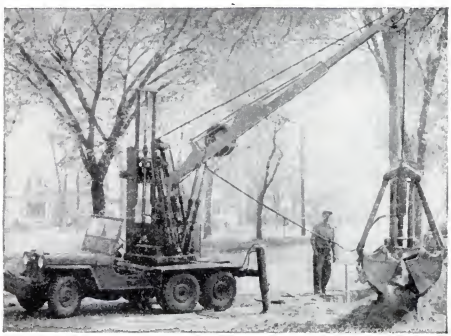
Spraying Mantis is the apt name of a British helicopter planned to shower insecticide on nearly 500 acres a day through its 100 nozzles. It will carry four tons of insecticide or fungicide, depositing about 50 gallons per acre. The spraying attachment has a 90-foot span. Normal operating speed for the helicopter, which is still in the design stage, is 80 m.p.h.

With insecticide showering from 100 nozzles, the Spraying Mantis can cover nearly 500 acres in a day. Designed specifically for pest control work, it holds four tons of insecticide or fungicide

Farmer & Stock Breeder photo



Jeep Carries Lightweight Crane and Provides Power for Road Work



Another job has been shouldered by the versatile jeep: carrying a compact hydraulic crane for light road work. With hoisting power furnished by the idling jeep engine, the crane spots its bucket or hook at any point within reach of a complete circle. The bucket is closed by hydraulic power instead of the standard two-cable device used on many larger cranes.

¶An Australian air line provides colorful felt toys and dolls for children and small cots for naps.

By John L. Kent

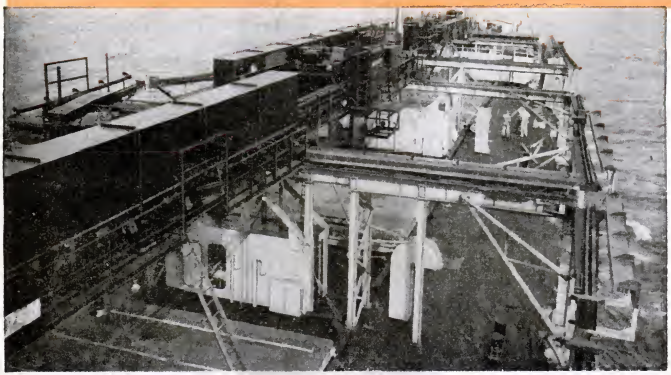
A QUEER-LOOKING ship in an east coast port is drawing excited comment these days. It might be just another freighter except for one thing. It has no masts, booms or winches in the forward section.

Close inspection reveals strange rails supported high in the air on steel columns. Riding each pair of rails and spanning each loading hatch is an overhead crane of the type used in foundries and steel mills.

To the ship's crew, the engineers and the designers on board, the unorthodox apparatus represents an answer to the greatest problem in ocean shipping—how to load and unload a cargo

← Rail-riding winch now under test may replace the masts and booms of older vessels. Below, arms folded at sides of ship are extended above the dock to carry winch during unloading

SPEEDING THE OCEAN



ship in the most efficient way.

Since the days of sailing vessels, cargo has been swung out of ships' holds by cargo booms. All our Liberty, Victory and newly built C-type freighters are equipped with the traditional winch-operated mast-and-boom hoisting apparatus.

The new method of loading and unloading a ship, which may revolutionize the handling of cargo on ocean vessels, is being tested by the U.S. Maritime Commission aboard the SS Sea Hawk, crack C-3-type merchantman.

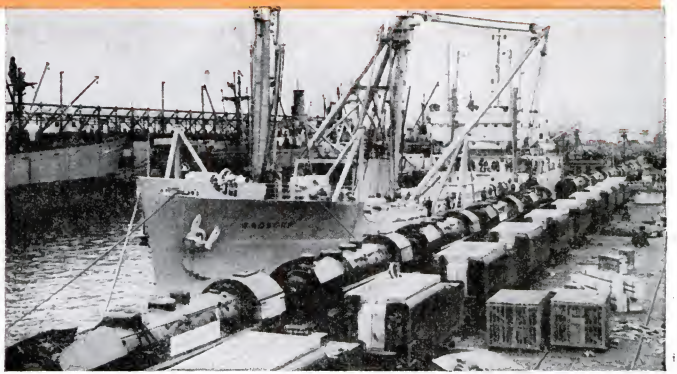
There is a reason for this and similar recent experiments with novel ship loading devices. On the successful outcome of any of these methods may depend the continued supremacy of the U.S. merchant marine.

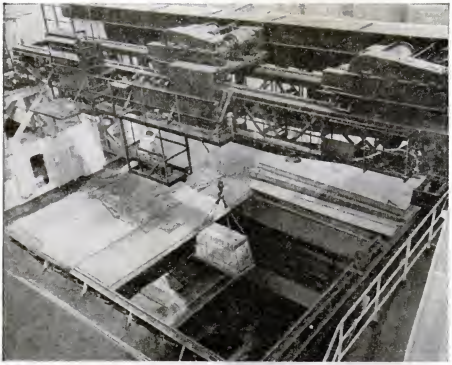
The United States emerged from the war with about 60,000,000 tons of ocean-going shipping. This is more than five times our prewar strength. Our fleet before the war constituted about one sixth of the world total. Today it is four sixths.

But the period of U. S. leadership, reminiscent of the Yankee Clipper era, won't last long unless ways are found to cut loading and unloading costs. England, Canada, Norway and other maritime nations are rushing construction of new ships. Once their ships, which are loaded, unloaded and manned by labor much cheaper than ours,

FREIGHT ABOARD

↑ 125-ton locomotive is loaded aboard the only ship in the nation with boom strong enough to support such weight. Below, more engines await loading





Load of pineapple is plucked from the hold by the new cargo handling gear. The load will move along the beam until it hangs above the dock

are afloat, the United States will be at a disadvantage.

To keep our ships in the lead, the U. S. Maritime Commission, shipowners and ship operators are experimenting with new types of loading and unloading equipment designed for more efficient service.

The Maritime Commission's design uses several overhead cranes, one over each hatch, to move the cargo into and out of the ship's holds. Three such cranes have been installed over the three forward hatches of the SS Sea Hawk. They run across the ship on folding tracks which can be extended outboard over piers or lighters.

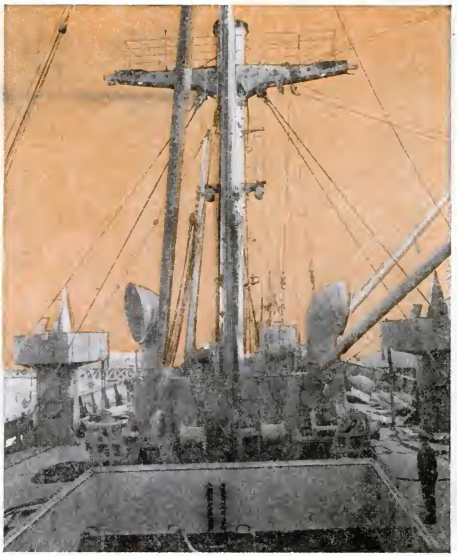
To load a ship, the two folded outrigger arms on which each crane travels are extended out from the ship's side over the pier. Large steel pins hold each track in the open position. An electric motor and hoisting winches, together with an underslung cab for the operator, ride the tracks, which are of a spur and pinion construction, thus assuring no slippage and exact control for spotting the cable hook. The cable is unwound and the stevedores hook up the pallet or ends of the full cargo net.

The electric motor gives a short whine and the hoist reeves up the cable. With the net or pallet hoisted clear of the ship's side, the entire crane mechanism rides back to stop above the ship's hatch. The operator lowers the cargo into the hold and the cable is unhooked. He then reels up the empty hook and rolls the crane back over the dock for another load.

Experimental performance of these cranes on the SS Sea Hawk showed them capable of handling cargo 15 percent faster

Rail extended, the experimental loading ship SS Sea Hawk is ready to discharge her cargo

Liberty ships have conventional loading gear consisting of several booms with individual winches



than conventional types of cargo gear with masts, booms and winches.

Stevedoring is the biggest single item in the cost of ship operation; twenty cents out of every dollar expended by American merchant marine goes for the handling of cargo. In the coastwise trade, the figure may run as high as 40 cents. In some trades it costs more to put cargo into a ship than it does to transport it.

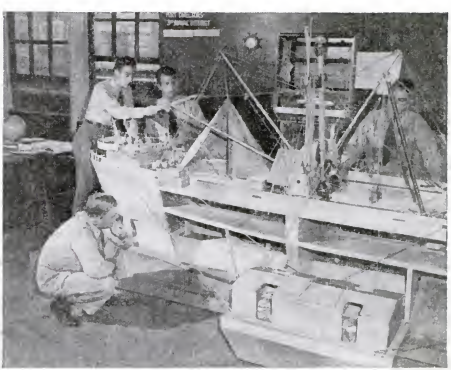
But loading and unloading a ship is only half the problem. The ship's master must stow the cargo to protect the ship and crew from damage and injury, protect the cargo from damage and make the best use of cargo space. He must distribute the cargo so that it can be promptly and readily unloaded upon arrival at scheduled ports.

The modern ocean-going vessel is provided with good-sized hatch openings and relatively clear holds. But there are still numerous problems to be solved. Stowage nowadays, for example, is frequently complicated by the fact that many vessels load cargo at several ports—for discharge at a number of foreign ports.

Take the case of the captain sailing from New York with a partial shipload of automobiles, cheese and condensed milk. He is ordered to pick up electric generators in Philadelphia and lumber, turpentine and cotton in Savannah. This cargo is to be unloaded about a month later in Brisbane, Sydney and Melbourne.

Generally he stows the cargo so that there is a fair distribution for each port throughout the ship. For example, if there are 500 tons of cargo for Brisbane, he places 100 tons in each of the five holds. This not only helps to make cargo for the various ports accessible at the proper time, but also speeds the discharge of cargo, since all

(Continued to page 260)



Ship model at Army-Navy Stevedore School helps teach young officers the secrets of loading

Latest Tanks Outweigh and Outshoot Wartime Weapons

Left, fast 60-ton tank has double the armor protection of earlier tanks. Lower left, tank-type land battlewagon mounts a 10-inch howitzer or (below) can be fitted with eight-inch rifle

Heavy high-speed tanks and land battlewagons mounting big guns are among the latest weapons developed for the Army. The new 60-ton tank has twice the speed of any other tank of comparable size and mounts a 90-mm. 21½-foot-long rifle which hurls a shell at three times the speed of sound—an armor-piercing power greater than any gun used during the war. Carrying a crew of five, the tank has double the armor protection of earlier tanks. The land battlewagon mounts either a 10-inch howitzer that can shoot a 360-pound shell 16 miles or an eight-inch rifle that hurls a 240-pound shell 27 miles. Despite its 63½-ton weight the battlewagon can travel 20 miles an hour. In contrast to previous mobile guns which took hours to set up and depended upon roads and railroads for transportation, the new artillery pieces are prepared for action in five minutes by backing the spade tail into the ground to resist recoil.

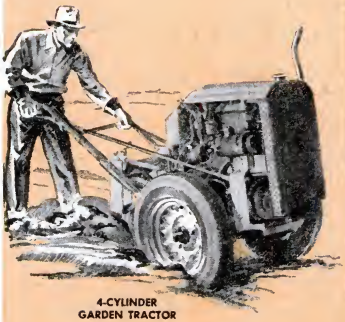
Tractor Built on "Stilts" Hauls Seine Into Lake

Discarded automobile, truck and tractor parts were used to build two elevated amphibious tractors which are employed to save time in hauling a 2400-foot fishing seine into a lake and back to shore. Lawrence N. Trombley, a commercial fisherman at Saginaw, Mich., designed the vehicles.

Popular Mechanics is always ready to supply further information to readers about various products described in any issue. Just write to Bureau of Information, Popular Mechanics, 200 E. Ontario St., Chicago 11, Ill., for a prompt reply.

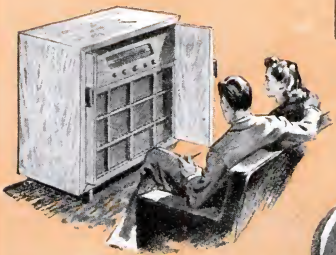
HOUSE TRAILER

The CRAFTSMAN

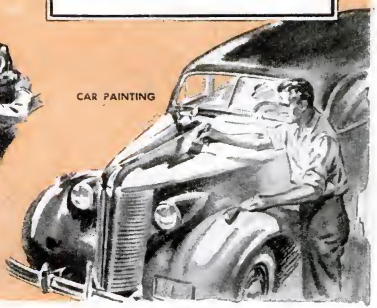


4-CYLINDER GARDEN TRACTOR

Set up housekeeping wherever you stop—that's something to dream about when you're planning to hit the open road. All right, make it come true by building PM's new house trailer. The how-to-build story starts on page 190 and here you'll find all that's good in trailer living for four people arranged on a floor space only 7 by 17 ft. That should be enough to start you off. And then along on page 222 there's a story on building a garden tractor from old auto parts. "So what," you say. But this one is powered by a 4-cylinder engine and that, brother gardeners, is really new in a "walking" tractor. The next offering, page 182, is a radio cabinet in modified modern design. Made of fine cabinet woods, it's easy to look at, especially if you built it yourself. With spring just around the corner, a story on page 200 gives inside information on how to do a bang-up job of car painting



RADIO CABINET



CAR PAINTING

Any of the fine cabinet woods make up nicely into this radio cabinet of modified modern design. Doors swing outward and then "telescope" into pockets in the sides of the cabinet

Furniture You Can Build p132

MODERN RADIO CABINET

By Gene Russell

WITH the exception of the novel "telescoping" doors, which open out and then slide back into pockets, this floor-type radio cabinet is almost as simple and easy to build as a box. Character and individuality of design are added by beading around the double-door opening, built-up door handles and one-piece inset wood legs or feet. Absence of curved parts on the exterior of the cabinet gives the whole job a pleasing plumbness of line that appeals to both the craftsman and the home decorator.

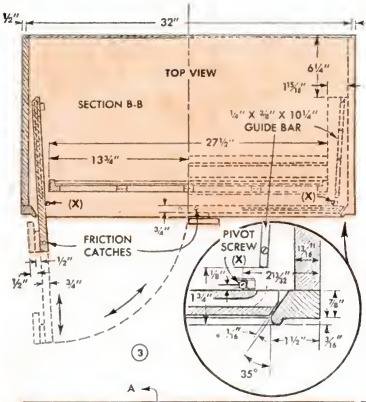
Due to the width of the sides, top and bottom, it will be necessary to build up to the required widths by edge-gluing several pieces together. Select the wood for quality and grain and cut all the pieces slightly longer and wider than the finished dimensions to allow for fitting. The kind of wood to use depends on the finish you desire. Plain oak will take a beautiful limed finish, which is especially popular on this modified modern design. Any of the other fine cabinet woods are, of course, suitable for finishing in the natural color, bleached or stained. However, if you like an enamel finish, then use a close-grained wood such as birch, gum or poplar.

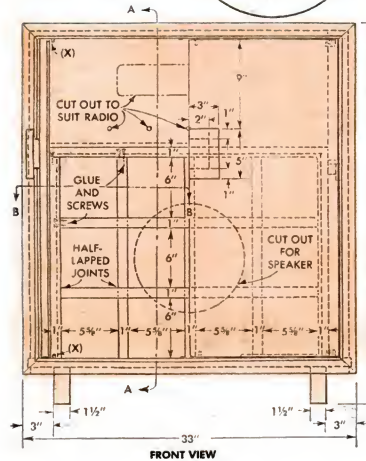
When clamping edge-glued work, you can save a lot of time and extra sanding by making sure that the edges are flush. Draw the bar clamps tight and then even up the edges by tapping lightly with a hammer. Wipe off excess glue with a damp cloth. Allow plenty of time for the glued joints to dry before releasing the clamps. Doors

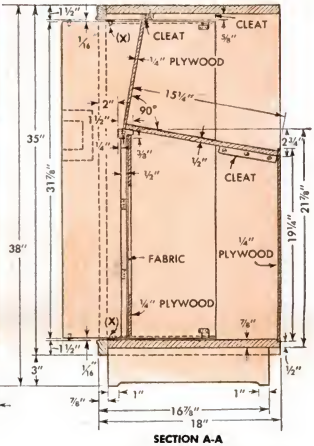
are built up to width in the same manner, making them slightly oversize all around so they can be trimmed to fit accurately.

This done, the pieces must be sanded smooth. On glued-up work such as this it often is necessary to go over the surface with a jointer plane in order to get it perfectly flat. After planing and sanding all pieces, you're ready to cut to size and join the parts. Cut a rabbet in the back edge of the sides and the bottom piece to take the back. Mitered joints at the corner of the cabinet give the best appearance but are more difficult to make. Clamping can be done by making four clamping cauls from 1 by 4-in. stock, each piece cut slightly longer than the width of the cabinet side pieces. Nail two 1 by 4-in. pieces together at right angles to make one caul. Then make the miter cuts on the four pieces which comprise the top, bottom and sides. Spread glue on the joining surfaces, set the parts together, block them in position and place a caul over each corner. Then draw up with eight bar clamps, two across each panel lengthwise.

Next, glue on the facing strip and beading, Fig. 1. Screw the back panel in place and the inclined shelf for the radio chassis, then the instrument panel and framework for the grille. A look at the three views in Fig. 3 will give you dimensions and location of these parts. Finally, "hang" the doors. Fig. 1 gives the details, Fig. 2 shows the doors open and Fig. 3 gives the position of the door in section. The pivot screw X is shown in position in Figs. 1 and 3. It likely will be necessary to make a trial fit in order to get the doors to work smoothly. Doors should be fitted with allowance for free movement and then finished on both sides and the edges. This adds to appearance and prevents absorption of moisture which might cause the wood to swell.







Cart Pull-Toy for Small Children Made From Gaily Colored Basket

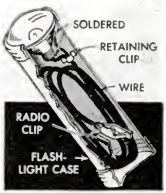
A delight to the heart of very young children, this pull-toy is made with a few odds and ends that are found in most workshops. The body of the wagon is a small basket that is woven of gaily colored materials. It can be reed, raffia, wicker or any other suitable material. Place the basket on a piece of plywood and trace the outline on the board. When cutting the base make it about ¾ in. oversize. Next cut the axle and allow it to overlap the base slightly. A length of sturdy dowel is cut to serve as a handle, with a smaller dowel to serve as a crosspiece. Two corner irons are screwed to the wooden axle and roller-skate wheels are bolted to the irons. The entire assembly is bolted or screwed together. Touches of color can be added here and there with a crayon, after which all parts of the toy are given protective coatings of shellac.—Simon S. Palestrant, Bronx, N. Y.

Drop Lid of Sewing Machine Serves as Bed Table

If you have no bed table, the lid on a drophead-type sewing machine will do in an emergency. Simply wheel the machine in position and open the lid so it extends over the bed and covers the patient's lap. The table can be used for meals, as a writing desk, for reading or for playing games.
Mrs. F. J. Miller, Bakersfield, Calif.

Flashlight Used as Trouble Lamp

You can make good use of an old flashlight by converting it into an auto trouble light. After the cells have been removed, solder a wire to the end of the bulb and another to the back of the reflector. The other ends of the wires are fitted with radio or battery clips. The light is used by attaching the clips to the battery terminals, or to the motor or frame and any "hot-wire" terminals. The wires should be long enough so that the light will reach any part of the car. It will be necessary to use a 6-volt bulb. When not in use, the wires and clips are stored inside the flashlight case.

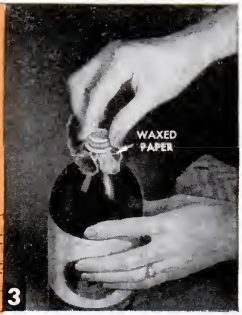


Recoloring Worn Spots on Rugs

When a rug becomes worn in spots, these areas sometimes take on a color that is lighter than the rest of the rug. To remedy this defect, get some dress dye the same color as the rug and brush it on the threadbare spots. Such parts will then blend with the rest of the rug. This "touch-up" may be used for rugs of one color or those having a closely blended pattern.

SOLVING HOME PROBLEMS

To avoid soiling a recipe and to keep it handy while preparing food, use a celluloid "envelope" with a cardboard support bracket into which the recipe can be slipped

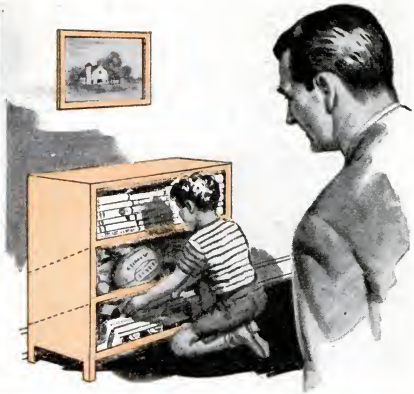


1. Shelling popcorn with bare hands is apt to result in sore and tender palms. However, this trouble can be avoided if an ordinary grater is used and the corn is shelled into a cake pan. Shell enough for several "poppings" and store in a sealed paper bag

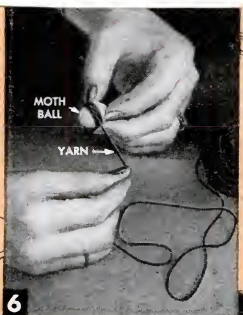
2. One of the blades salvaged from a broken or discarded pair of scissors makes an excellent seam-ripping tool for home upholsterers. Grind a shallow notch in the cutting edge near the tip of the blade and sharpen both sides so seams can be ripped easily

3. Because of the nature of their chemical composition, many bleaching compounds have a corrosive action on the metal cap of the bottle that serves as a container. This corrosion can be avoided if a waxed-paper lining is used under the cap as shown

4. A scrollsawed strip of wood across the inside of the top of a jewel box makes an ideal rack for holding earrings. It will save time when hunting for them; keep pairs properly matched and guard against damage which might occur if they were left loose in the box



Above: If you have rusty spots on the refrigerator racks, remove them with fine steel wool and then wash in soapy water. After the racks have dried, cover the rusted spots with colorless nail polish to prevent any further spread. Right: To keep a youngster from cluttering up his room, use a vegetable bin for toy storage



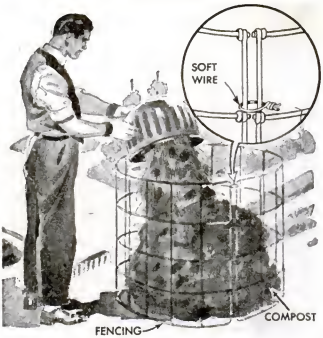
5. To avoid getting scratched by the ends of tiny feathers that work through a pillow, remove the feathers and turn the ticking inside out. Go over the ticking carefully, pulling out all feathers that may be sticking through. Then press with a hot iron coated with beeswax

6. When winding yarn from a hank into a ball, use a moth ball as the core. This will protect the yarn against damage when it is stored or not used for some time. If considerable yarn is kept in one box, it's also a good idea to scatter moth balls in the box

7. Sew a horizontal seam, with both ends open, at the lower end of an apron. This should be of a size to accommodate several kneeling pads. When scrubbing a floor or performing some other task that requires working on your knees, the apron will come in handy

8. An easy way to clean venetian blinds is to use a photo-film squeegee of the type that consists of a soft sponge on each end of a pair of tongs. These can be obtained in most photographic supply houses. Clean the blinds with a solution of soap and water

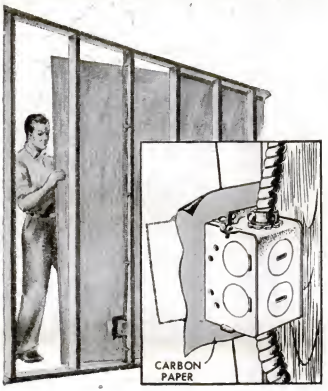
Woven Fencing Used as Form For Piling Compost Neatly



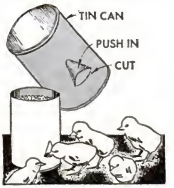
As a means of preventing his compost pile from spreading over the ground, one gardener enclosed it with a circular form made of woven-wire fencing. The ends of the fencing are wired together so that the form can be removed when it is full. Then the form is set in a different location for filling again.—J. Krill, Youngstown, Ohio.

Position of Outlet Box Is Marked By Using Carbon Paper

To mark the position of outlet boxes when installing wallboard, one carpenter tacks a sheet of carbon paper over the box with the carbon side out. Then he places the panel of wallboard in position and presses it firmly against the box. The outline of the box is left on the board and it's a simple matter to cut the hole to fit.—R. L. MacLean, Prince Edward Island, Can.

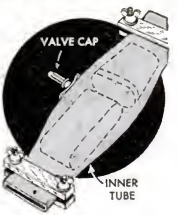


Chicken Feeder From Tin Can



Whether you have a few, or many, chickens to feed, this feeder will do the job well with little waste of grain. A slot is cut near the bottom of the can and a small indentation is formed with an opening in the can. If a lid is placed on the can, it will prevent fowl from wasting feed out of the top.—Wm. P. Houser, Organ, N. Mex.

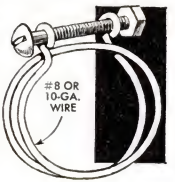
Keeping Hunting Equipment Dry



When hunting from a boat, or on a boating trip, you can keep guns, binoculars and other valuable equipment dry with this watertight container. Cut a piece of inner tube that is long enough to contain the equipment you wish to carry. Close the ends with pieces of hardwood clamped together with bolts and wing nuts. If the length of tube selected contains the valve, you can inflate the container so it will float if dropped in the water.

C. L. Meehan, Lakeview, Ont., Can.

Wire and Bolt Make Hose Clamp



If a hose clamp is not at hand, a substitute can be made from No. 8 or 10 wire. Wrap the wire around the hose twice and bend an eye at each end. Then slip a bolt through the eyes and tighten.

¶Ring or earring stones that have loosened or fallen out can be reset by using colorless nail polish for glue. The polish will dry quickly and is waterproof.

Bracket Table Saves Space in Narrow Hallway

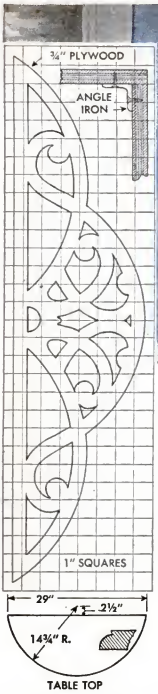
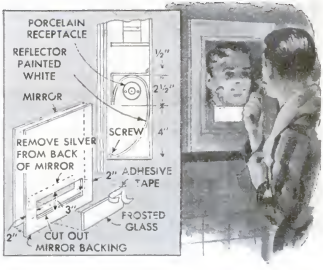


Table legs in a narrow hallway are very much in the way during the weekly housecleaning. Moreover, they make a small hallway appear even smaller and more congested. But mount the table top on a scrollsawed wall bracket and you gain in both space and decorative values. In the crosshatched detail at the left, ¾-in. plywood is suggested for both pieces but instead you can use ¾-in. solid stock for the top and ⅜ or ½-in. plywood for the bracket piece. This makes the scrollsawing job a little easier, especially if you do it by hand. The scroll pattern is rather intricate in detail so sketch in the curved lines full-size on heavy paper. Then transfer the pattern to the wood. Bore all the holes necessary for insertion of the saw blade. Saw slowly. If you hurry the job you'll get rough, irregular edges here and there. Sand both pieces smooth, round the edges or shape them if you have power equipment, then finish with stain, shellac and wax or with clear lacquer. In assembly, the pieces are screwed to a short length of angle iron as shown. This takes the place of shelf supports so commonly used.

Edward J. Hobert, Hampstead, N. Y.

Indirect Shaving Light for Mirror-Front Medicine Cabinet

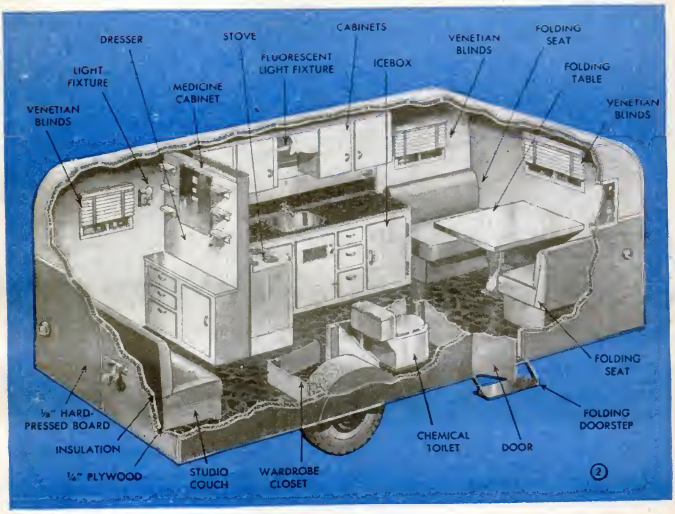
Any medicine cabinet with a mirror front can be improved by the addition of an indirect shaving light. The dimensions given here are approximate and it may be necessary to alter them in some cases. First the rectangular opening is cut in the backing and an area the same size is scraped on the back of the mirror, removing the silver. Frosted glass is taped to the backing to cover the clear area in the mirror. If the mirror has wood backing instead of metal, small clips can be used to hold the frosted glass. The reflector is made of light sheet metal. Then porcelain receptacles are mounted on each side of the cabinet inside the reflector. A toggle switch will control the light.—G. M. Singer, Erie, Pa.



REFER ALL INQUIRIES TO: WILLIAM O. DAWSON
(DAWSON IS BUILDER). 5012 SIERRA ST.
RIVERSIDE, CALIF.

A Home of 1000

①



②

LB #121

Addresses

All facilities for housekeeping are built into this trailer, which is 7½ by 17 by 6 ft. 4 in. inside and sleeps four comfortably. Any car will easily tow it and an all-steel chassis and rugged framework permit it to roll along safely over the roughest roads

By Hi Sibley

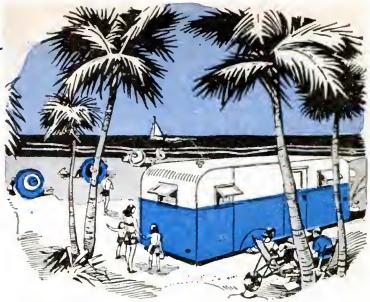
PART 1

SHORT enough to park easily and take through any kind of traffic, the house trailer in Fig. 1 will take care of four comfortably whether it be a week-end trip, a vacation or an extended tour of the country. Neat appearance and a compact yet roomy interior have been obtained without difficult compound curves or complicated carpentry—just a strong framework set on a welded, all-steel chassis of angle iron, Fig. 10.

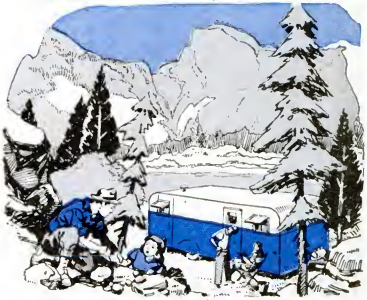
Before starting work on the chassis or frame, you should acquire all inside equipment, Fig. 2, and then build the structure to fit, retaining over-all outside dimensions. The bill of materials, Fig. 5, lists major items.

Dimensions are given in Figs. 3 and 4. Angle beams ¼ by 2 in. are welded crosswise under the main frame, which is a 3-in. steel channel having a plate welded to the open side to form a strong box-beam as indicated in Sec. B-B, Fig. 4. Forward ends are brought together in a vee and further strengthened with two 1¼-in. angle irons and a triangular plate, which is welded across the end. Mountings for the spring shackles are welded to the angle beams, which also are boxed for a length of 18 in. by welding on a second angle as indicated in detail A of Fig. 4. Ten-leaf springs ¼ by 1¾ by 34 in. are used. When tightening the bolts in the spring eyes draw up the nuts snugly and then release them half a turn. This will prevent them from binding.

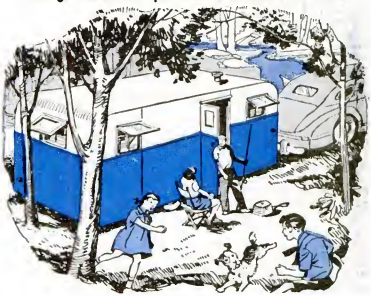
Next come the floor joists, which are 2 by 3-in. stock set on edge to be the same height as the steel main frame. They are bolted to the cross-beams as in Sec. B-B, and the heads countersunk. Several makes of axles



It doesn't matter whether you wish to spend a week end, a few days, a month's vacation or the summer at a beach, in the woods or at your favorite lake . . .



or maybe make frequent trips to an isolated spot high up in rugged mountain country, this trailer will get there and provide the comforts of home

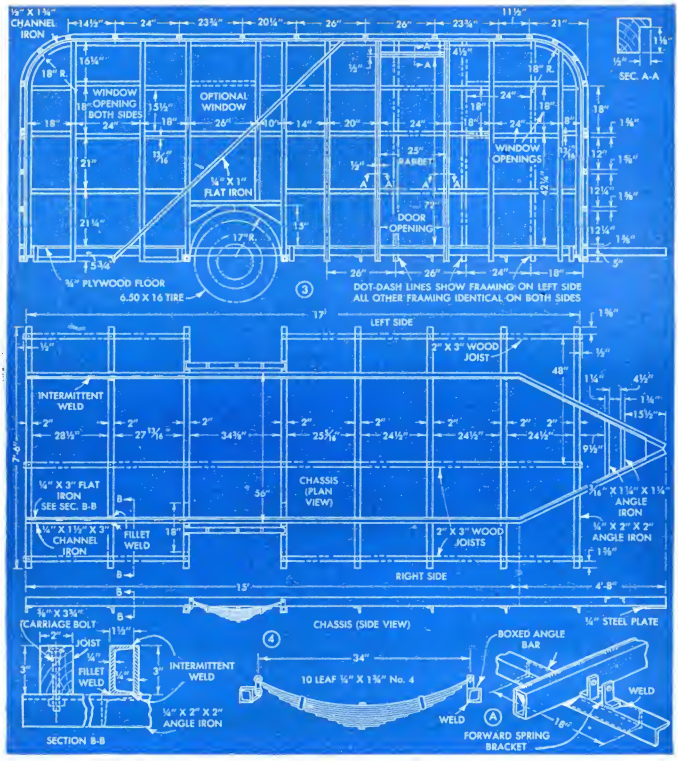


And if you like to take week-end fishing or hunting trips to some favored locality, the trailer provides a comfortable overnight home for you and your family

will be suitable. The one used in the original trailer was tubular with a 2-in. drop. Type of brakes used is a matter of choice but they should be installed according to manufacturer's recommendations. However, if electric brakes are used, anchor the cable along the axle as well as the frame with steel clips welded on as in Fig. 6.

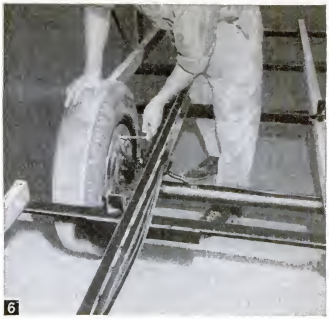
The three floor joists are indicated by dot-dash lines in Fig. 4. Note that one joist is off center 48 in. from the left side to permit using a full-width plywood panel here. The plywood floor, which is ¾ in. thick, is glued to the joists and further secured with countersunk screws. Both ends of the floor extend beyond the joists, making a total of 17 ft. 1 in. This is to fill ½-in. gaps in the ends caused by channel-iron framing.

All of the wooden framing is 2 by 2-in. stock, S4S (surfaced all four sides), and every joint is glued. Before starting the frame, the windows, vent and door should be obtained so that suitable openings can be allowed. End windows are identical and the four in the sides are of the same size, 18 by 24 in. Dimensions for the left and right sides of the framing are shown in Fig. 3. Dimensions for the front and rear are given in Fig. 9. Cross members of the window openings are glued and screwed with ¼ by 4-in. lag screws. Other horizontal members are glued and toenailed where necessary. They are located so that a 4-ft. panel of tempered, hard-pressed board



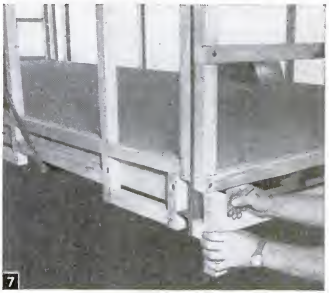
(5) BILL OF MATERIAL

40 lin. ft.	¼x1½x3 in.	Channel iron
60 lin. ft.	3/16x½x1¾ in.	Channel iron
63 lin. ft.	¼x2x2 in.	Angle iron
4 lin. ft.	3/16x1¼x1¼ in.	Angle iron
40 lin. ft.	¼x3 in.	Flat iron
20 lin. ft.	¼x1 in.	Flat iron
32 lin. ft.	¾ in.	Rolled-edge aluminum molding
112 lin. ft.		Stainless steel corner molding
90 lin. ft.		Stainless steel dividing strip
112 lin. ft.	#12	Two-wire 110-V. cable
52 lin. ft.	2x3 in. (net)	Clear Douglas fir
600 lin. ft.	1⅜x1⅜ in. (net)	Clear Douglas fir
12 lin. ft.	2x8 in.	Clear Douglas fir
18 lin. ft.	2x4 in.	Clear Douglas fir
2 pieces	⅜ in. x 4x6 ft.	Plywood
18 pieces	¼ in. x 4x8 ft.	Plywood
5 pieces	¾ in. x 4x8 ft.	Plywood
18 pieces	⅛ in. x 4x8 ft.	Tempered hard-pressed board
12 rolls	3 in.	Processed-cotton automotive insulation
136 sq. ft.		Floor linoleum
16 sq. ft.		Sink linoleum
40	¼x4 in.	Lag screws
20	¼x2½ in.	Lag screws
70	¼x2½ in.	Carriage bolts
35	¼x4 in.	Carriage bolts
65	5/16x2½ in.	Carriage bolts
24	⅜x3¾ in.	Carriage bolts
1 gross	1½ in. #8	Flathead screws
1 gross	½ in. #2	Flathead screws
½ gross	¾ in. #6	Round-head screws
½ gross	1 in. #7	Round-head screws
4 gross	1¼ in. #9	Nickel-plated oval-head screws
2 gross	1 in. #7	Nickel-plated oval-head screws
4 gross		Nickel-plated flush-face washers
3 quarts	Caulking compound	
4	Running lights	
2	Taillights	
1	Stop light	
1	Male and female connection for 110-volt lights	
4	Octagon outlet boxes	
2	Duplex receptacle boxes	
2	Duplex receptacles	
2	Duplex receptacle plates	
1	Trailer hitch	
1	Trailer axle	
1 set	Electric brakes	
2	¼x1¾x34 in. 10-leaf springs	
1	Trailer folding step	
1	Trailer stove (4-burner with oven)	
1	Trailer sink and fittings	
1	Trailer icebox	
1	Trailer tilt-back davenport	
1	Trailer roof ventilator	
2 18x33 in.	Trailer windows with screens	
4 18x24 in.	Trailer windows with screens	
1	Pullman bed	
1	Medicine cabinet	
1	Chemical toilet	
1 10 gal.	Butane tank and regulator	
18 lin. ft.	High-pressure copper tubing	
	Light fixtures (to suit builder)	



6

Connecting the electrically controlled brakes. Clips are welded to the axle housing to hold electric cable

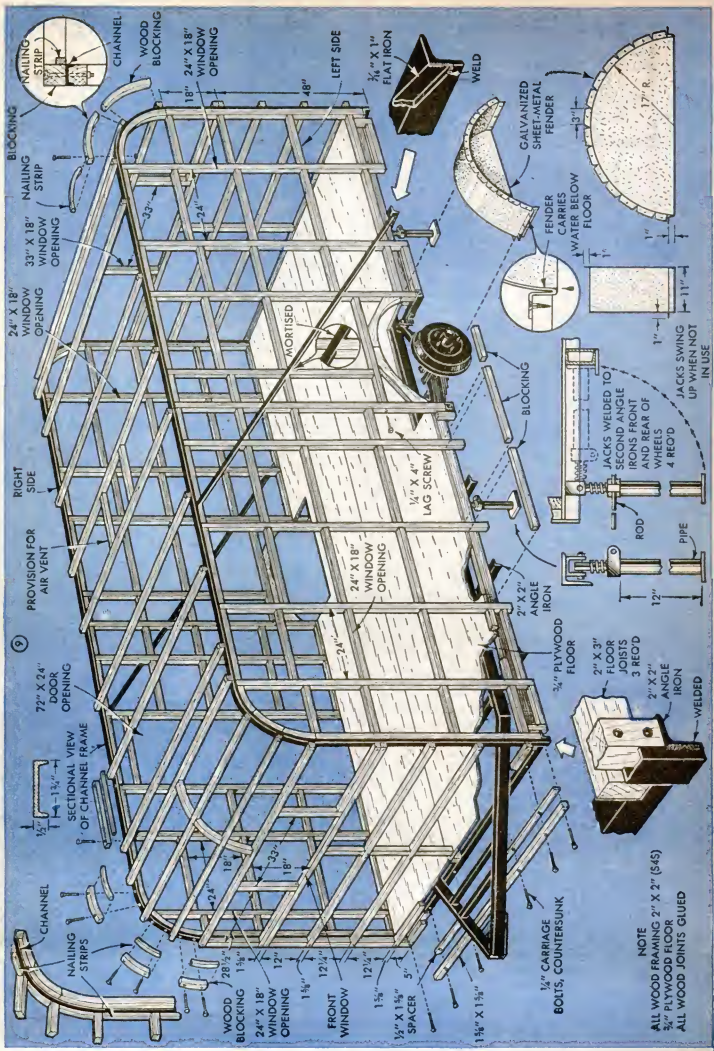


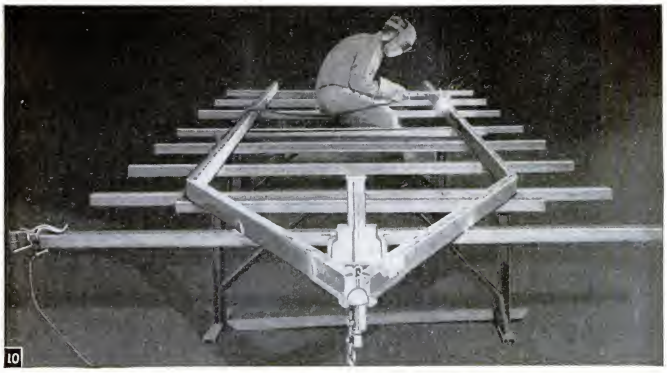
7

Completing corner blocking. These blocks should be a snug fit. Angle brace at left is mortised in flush

8

The sheet-metal fenders are carried down below the floor line to prevent water from seeping in onto floor


NAILING STRIP
CHANNEL
WOOD BLOCKING
24" X 18" WINDOW OPENING
LEFT SIDE
3/4" X 1" FLAT IRON
WELD
BLOCKING
NAILING STRIP
33" X 18" WINDOW OPENING
24" X 18" WINDOW OPENING
RIGHT SIDE
PROVISION FOR AIR VENT
72" X 24" DOOR OPENING
SECTIONAL VIEW OF CHANNEL FRAME
CHANNEL
NAILING STRIPS
WOOD BLOCKING
24" X 18" WINDOW OPENING
FRONT WINDOW
1/2" X 1 1/2" SPACER
1 1/16" X 1 1/2"
1/4" CARRIAGE BOLTS, COUNTERSUNK
MORTISED
1/4" X 4" LAG SCREW
24" X 18" WINDOW OPENING
2" X 2" ANGLE IRON
3/4" PLYWOOD FLOOR
2" X 3" FLOOR JOISTS 3 REQ'D
2" X 2" ANGLE IRON
WELDED
BLOCKING
JACKS WELDED TO SECOND ANGLE IRONS FRONT AND REAR OF WHEELS 4 REQ'D
ROD
PIPE
JACKS SWING UP WHEN NOT IN USE
GALVANIZED SHEET-METAL FENDER
FENDER CARRIES WATER BELOW FLOOR
NOTE
ALL WOOD FRAMING 2" X 2" (S4S)
3/4" PLYWOOD FLOOR
ALL WOOD JOINTS GLUED



10

Complete metal chassis set up for welding. Main frame members are steel channels with a steel strip welded to the open side, forming a box beam. This results in a nontwisting frame that will support heavy loads

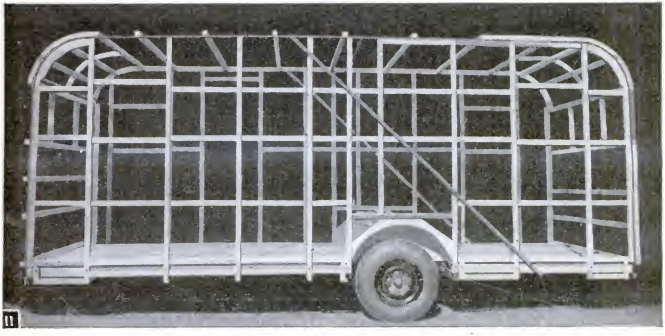
will meet on the center line. All studs are bolted at the bottom to the floor joists and at the top through the channel frame previously installed. Horizontal members are then placed. Note the blocking on top and bottom of the channel frame. This is to serve as nailing strips for the plywood walls on the inside and hard-pressed board on the outside of the double walls as well as the roof. Blocking for the curved upper corners is bandsawed from 2-in. material. Fig. 11 shows this blocking in place.

The doorframe is rabbeted ½ in. as indicated in Sec. A-A, Fig. 3. Along the bottom of the sides, blocking is installed between studs where shown; between some of them the nailing piece must set on top of the angle beam, Fig. 7.

Curved nailing pieces are installed in the wheel wells to hold the upper flange of the fenders, which are of galvanized sheet iron, the lower edges being bent to form a flange as well as an extension, which comes below the floor to carry off water. There also is a flange on the outside curved section. Fig. 8 shows the completed fender.

Four jacks are hung on brackets welded to the chassis and when not in use swing up and are screwed against a hanger.

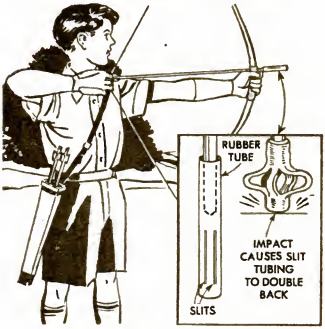
(To be continued)



11

Here you have the frame structure nearly completed with most of the curved blocking in place at the upper corners. This square box construction modifies streamlining but it gives you much more headroom at the ends

Slit Tubing Over Point of Arrow Lessens Danger to Others



To shorten the range of arrows and minimize the danger to others, one parent puts a protective head on the arrows of his son's archery set. The head consists of a length of rubber tubing with 5 slits about 1 in. long. These heads are slipped over the points and serve to break the impact when the arrow hits an object.

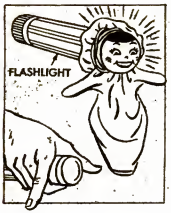
Emergency Portable Camp Stove

An improvised portable camp stove is assembled easily from the base of an old kerosene lantern and a 1-gal. can or pail. Punch holes about 1 in. from the top and the same distance from the bottom of the pail or can to provide draft. Then place the lantern base inside the inverted pail and adjust the flame to reduce smoking. Enough heat will be furnished to make coffee and warm small amounts of food.

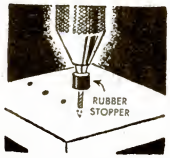
D. E. Horn, River Forest, Ill.

Animated Doll Amuses Children

With a flashlight, a handkerchief and a bit of paint, you can make a toy doll that will be a delight to youngsters. The handkerchief is fastened over the lens with a rubber band and a face is painted on this area. Then the rest of the handkerchief is shaped to simulate a body and arms. To manipulate the arms, insert the thumb and forefinger in the sleeves, holding the light as indicated in the lower detail. When turned on, the light animates the face.



Stop on Drill Prevents Damage

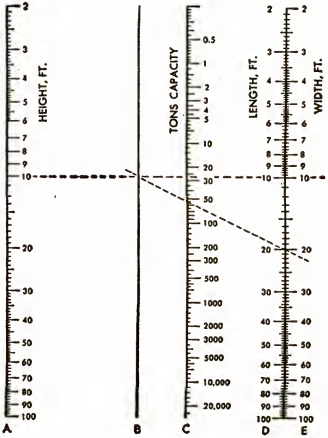


Users of push drills find that unless extreme care is exercised, the drill will break through and mar finished work. To prevent this, one craftsman slips a rubber stopper over the shank of the drill which cushions the shock when the point breaks through.

A. H. Waychoff, Phoenix, Ariz.

Chart for Approximate Tonnage

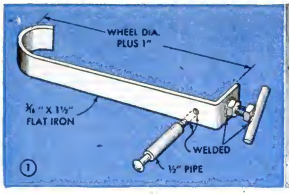
Although not exact, this chart will enable you to estimate the approximate tonnage of coal in a bin from its dimensions. To use the chart, locate the height of the bin on column A. In the example this is given as 10 ft. Then find the width, also 10 ft., on column E. Connect the two points and note where the line crosses column B. From this point, project a line to the length, 20 ft., on scale D. The tonnage in the bin is indicated on C where the line from B to D intersects it. In this case the answer is about 55 tons. This chart is based on 2000 lbs. per ton.—W. F. Schaphorst, Newark, N. J.



LLB 124

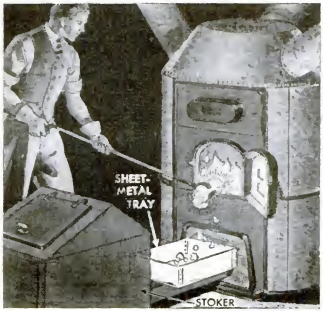
Lawn Mower Wheel Crank

Makes Sharpening Easy



Velvet-smooth cutting edges on lawn mower blades are something you think about when pushing a dull mower through heavy grass. A professional job of sharpening is quite simple as you can see from Figs. 1, 2 and 3 and the upper right-hand photo. First, make a wheel crank as in Fig. 1 and attach it to one drive wheel with the clamping screw shown in the detail, Fig. 1. Then clamp the mower in a vise, remove the drive wheels and interchange the reel-driving pinions as in Fig. 2. Replace the drive wheel to which the crank is attached. Then set the bed knife, Fig. 3, so that the blades "drag" very lightly when the reel is turned backwards. Mix medium-grade emery powder with crankcase oil to the consistency of thick cream and drop or paint the mixture on the edges of the blades. Turn the crank, spinning the reel backwards at moderate speed. Reset the bed knife and continue the operation until the blades are uniformly sharp. Finally, clean, oil, and reassemble the mower.

Merlin Dappert, Taylorville, Ill.

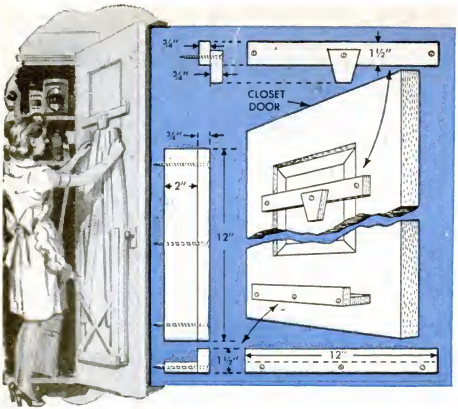


Metal Tray for Stoker Clinkers

←When removing clinkers from a stoker, a sheet-metal tray is convenient to keep them off the floor or from endangering shoes and clothing. The tray rests on the sheet-metal housing covering the feed. A lightweight metal will do and the tray can be of riveted or welded construction.

Screen Replaces Broken Window

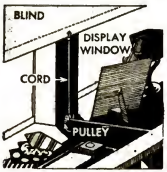
To replace small broken window panes, cut wire-screen cloth the same size as the broken pane. Suspend the cloth in a tray of shellac, remove and allow to dry. The shellac should fill all the holes. This pane will keep out wind and rain and will admit a fair amount of light.



Ironing Board Holder

With this on-a-door holder it's easy to keep an ironing board in place. The base, which supports the board, is made according to the dimensions in the detail, although it may be necessary to alter them to fit some ironing boards. The manner in which the upper cleat is made is shown in the upper detail. Some boards are constructed in such a way that the legs won't stay up if they face out from the door when placed in the holder. In this case the legs should rest against the door.—J. F. Grece, New York.

Blind in Show Window Lowered Without Disturbing Display



One merchant found that it was possible to raise and lower the blind in his display window without having to step among the articles on display to reach the blind. A small pulley was screwed to the base of a column that divided the window, and a cord was run from the blind through the pulley to the back of the display so that the blind could be raised and lowered from that point.—Ray Harrison, Fort Qu'Appelle, Sask., Can.

Perfume Atomizer Used to Spray Glaze on Pottery

The spraying unit from a discarded perfume atomizer is excellent for spraying glaze on small pieces of pottery before they are fired. Or it can be used to lacquer pottery or other similar craft projects. If the glass container is broken, a test tube with a rubber stopper can be used as a reservoir.

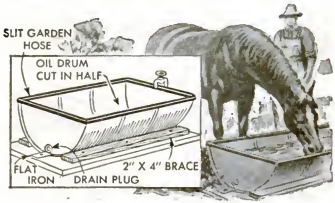
Stains Removed From Upholstery

Many stains on upholstery can be removed with a solution consisting of oxalic acid granules, 1 teaspoon, dissolved in water, 1 pt. Wet the stain repeatedly and, for the last step, make a paste of the acid, using fuller's earth. Spread this over the spot and, when dry, brush it off.

Francis W. Henry, Pottsville, Pa.

Small Watering Trough for Stock Utilizes Discarded Oil Drum

Of simple construction, this watering trough is made by cutting an oil drum in half. Before the cut is made, however, check to be sure that the drain will be at the bottom. Slit garden hose is placed over the edges of the trough to protect the stock from any irregularities in the metal caused by cutting. The tank is held in position by wood braces along the sides and a short piece of flat iron bolted over the lip at each end. The trough rests on a wooden platform.—Victor H. Lamoy, Upper Jay, N. Y.



Luminous Decoration Is Home Convenience

1

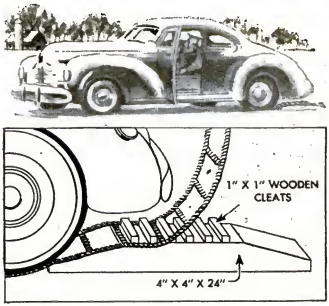
Paint that glows in the dark has many uses in the home, some practical and others decorative

2

Luminous paints that are available in several colors have varied applications in the home, some for convenience and others for novel decoration. The illustration in the upper right-hand corner is a combination of both. Where the lamp shade has been coated with the paint, it will glow in a dark or semidarkened room. This is decorative and it also serves to locate the lamp when it would not otherwise be visible. A wall stencil can be used for the pattern and the paint is applied with a small pointed brush. Another decorative treatment is to apply the paint to decals that often are used in bathrooms, playrooms and kitchens. Cover only the white part of the decal, lower left-hand photo, and when the room is in darkness a new pattern will appear. The name plate, upper left-hand photo, has a hard-pressed board base and utilizes the letters found in alphabet macaroni. They are waterproofed by dipping them in thin, clear fingernail polish, and after drying are coated with luminous paint and fastened to the board with cellulose cement. A rubber band is fastened around the board when applying the letters to serve as a guideline.—Kenneth Murray, Colon, Mich.

Tire Chains Put on Automobile Wheels With Aid of Wooden Block

If you're driving in territory where snow is apt to be deep, putting chains on auto wheels is a difficult and slow task, but if you carry a block similar to the one in the lower detail it's no trick to get the chains on in a hurry. A 4 by 4-in. block 24 in. long with a shallow bevel at each end is fitted with cleats; the cross links of the chain fit into the spaces formed by the cleats. With the chain in place, drive your car on the block, bring the ends of the chain around the tire and fasten them. Repeat for the other rear wheel.



¶Leather chairs and other leather goods can be kept clean and shiny by rubbing them frequently with egg whites which have been beaten to a stiff consistency.

Motorists' Handbook p. 94

HOW TO PAINT YOUR CAR

Painting makes the old car a lot easier to look at and adds many dollars to its trade-in value

By Charles Smith

TO PAINT, or not to paint. Likely you've considered the question, but after another studied look at the battered old bus, you decided that a commercial paint job was too expensive and a home job too complicated. But with several hundred names ahead of you on the dealer's list for a new car, maybe it does deserve a new paint job. Also keep in mind that painting will add a hundred dollars or so to trade-in value. So, if you are willing to take a little extra care in the preparation of a good painting surface, use the right paint and approved methods of application, you'll finish up with a paint job that'll make you wonder for a while whether this is really your car.

Preparation's the thing. At the start, take off all parts that can be readily removed such as the radiator grille, Fig. 1, and cover all other areas you don't want the paint to hit, with masking tape, Figs. 6, 7 and 9. Perhaps the most tedious part of the whole job is "bumping" out deep scratches and dimples that every car body suffers after several years of use. Usually it will pay to have the worst of the bends and dents taken out by a reputable body shop. But you can level shallow fender dents with a bumping hammer and dolly block. This job gets easier after you try it. In treating an ordinary shallow fender dent, the trick is to begin at the edge of the depression and work inward. Easy on the hammer does it. No hard blows, just a light tapping, and always taking the hammer blow on the dolly held against the opposite side of the metal. With this simple procedure you can iron out ordinary body and fender dents without leaving a trace. Usually there'll be rust spots along the lower edges of the fenders and doors. These can be sanded out by hand, Fig. 3, or removed with a motor-driven disk sander, Fig. 2. For hand work

First step in preparation is to remove all the bright work, such as radiator grille, head-lamp rims and hub caps

1

A motor-driven disk sander helps a lot in preparing a good surface for either enamel or lacquer

2

Reprinted - How to Paint Mot[illegible]
[illegible] + spray

You can do all the sanding and smoothing by hand where the body and fender metal is in good shape

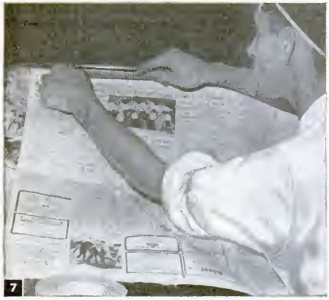
After sanding do a thorough job of cleaning body and fenders, using a cleaner made especially for the purpose

5

In cleaning up, pay special attention to exposed portions of the rear deck, for here's where dirt collects

6

Above, mask glass and trim, using masking tape to cover small parts and to hold newspapers as below



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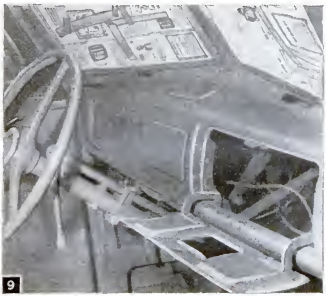
use No. 100 dry sandpaper and for the machine No. 80 grit. In using the machine, watch the work closely for the high-speed disk cuts very fast. Finish all sanded areas with No. 240 grit. Then go over the whole body with a prepared cleaner as in Figs. 4 and 5 to remove the accumulated road grime and loose pigment from the original paint coats and also any grease that may be on the surface. Next, any areas where the metal has been bared in the preparatory steps will need to be primed before the final painting or lacquering. Use either an enamel or lacquer primer depending on which you are going to use for the finish.

Most ordinary quick-drying, self-leveling enamels used in car finishing can be applied with a brush without any trouble with brush marks or laps. It takes these finishes nearly an hour to dry dust free so precautions against dust must be taken. One of the best ways to do this is to work with the car in the garage. Then, just before you begin painting, spray the floor with water and go over the car with a painter's tack rag. Plan the procedure so that you can finish all the large surfaces without any lapse of time. In painting the top, for example, keep working back and forth across the width. Don't paint half the top area and then the other, because the edge of the painted area you have just covered will have started to set and you'll likely have some trouble getting a smooth lap. On the large surfaces always finish the work to the edge before you stop. Lay the enamel on with a well-filled brush, using short strokes and light pressure and do not brush it out as you would an oil paint. Be careful at the lower edges of the fenders that the brush does not pick up dirt or sand. It's a good idea to wipe or brush these lower edges before you bring the enamel down to them. Although enamel sets dust free in an hour or so, the job

should not be touched or the car moved for at least 48 hours after you've finished enameling. Then wait two weeks before you do any polishing, or "compounding" as it is sometimes referred to in body shops. Actually, there's little need for a preparatory rubbing on an enameled job. Just wipe it with a soft cloth at the end of a couple weeks and wax in the regular way.

A lacquer job requires application of a lacquer undercoater or sealer, made especially for the purpose. Both the undercoater and the lacquer must be applied with a spray gun, Fig. 8. In spraying you don't have to be quite so particular about laps as the sprayed coat is much thinner. However, there are several tricks in handling a spray gun that one should know about. First, dilute both the undercoater and the lacquer exactly as the manufacturer directs for spray-gun use, be sure that the gun is clean and properly adjusted, then, in spraying vertical surfaces, hold the gun level about 6 to 8 in. from the surface and make sweeping back-and-forth strokes, releasing the trigger at the end of each stroke to avoid "piling" up the sprayed material at the edges of the area being covered. Don't use a circular or zigzag stroke except possibly where it is necessary to cover small irregular-shaped objects. Hold the gun at an angle of about 45 degrees when working on horizontal surfaces. As in hand brushing, finish up small areas at a time. Don't spray-paint one side of the car from end to end and then the other side the same way, but rather finish the hood, a fender or a door panel separately. Take the same precautions against dust as in hand brushing. If you work inside the garage even more elaborate precautions are sometimes necessary as the air blast from a spray gun will raise dust several feet away. Sprinkle everything nearby thoroughly and go over every part of the car with a tack rag before beginning work. If you work inside, wear an approved respirator. Although the quick-drying lacquers permit application of a second or third coat almost immediately, be sure that the material is thoroughly dry before applying another coat. Finish the whole car with one coat before applying the second to any part. Two to three coats of lacquer will be sufficient to produce a good job. Finish up by waxing in the regular way.



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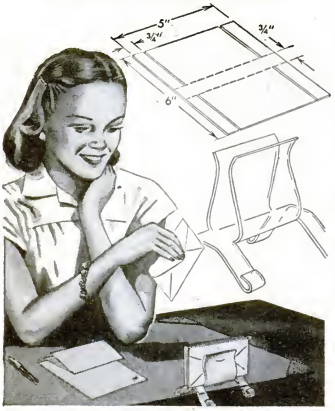
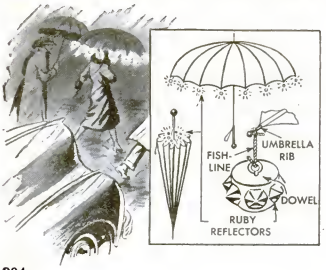
Attractive Plastic Letter Holder Made From Single Sheet



Attractive as well as useful, this letter holder is made from a single sheet of ⅛-in. plastic. Cut the material with a hacksaw to the dimensions given in the upper right-hand detail. Make each bend separately, being sure that the curves are symmetrical. After the piece has been formed, file the rough edges and then sand with progressively finer grades of sandpaper. Finally, finish with an abrasive polish to obtain a high luster.—Frank Shore, New York.

Reflectors Attached to Umbrella Warn Autoists of Pedestrian

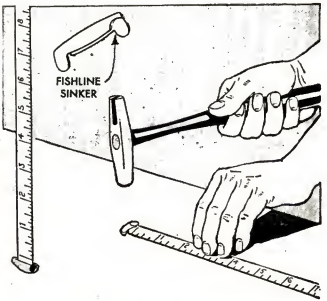
For those rainy nights when motorists' vision is poor, ruby reflectors attached to an umbrella will warn drivers of the presence of a pedestrian. A number of the reflectors are attached to a short piece of dowel which has a screw eye in one end. Fishline is used to attach the reflectors to the tips of the umbrella ribs.



Split Fishline Sinker on Steel Tape Provides Finger Grip

If you've lost the finger grip on a steel measuring tape, hammer a grip made from a fishline sinker in its place. This will serve to weight the line slightly when taking vertical measurements.

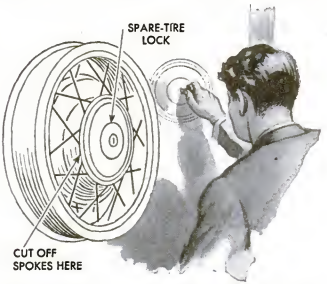
G. E. Hendrickson, Argyle, Wis.



Spare-Tire Lock as Wall Safe Protects Important Papers

You can make a wall safe to hold important papers by using a spare-tire lock, of the type shown, and an auto wheel that fits the lock. The spokes of the wheel are cut close to the hub and the latter is then recessed in the wall. Any opening around the hub should be covered so that it appears flush. After the safe is in place, a picture may be hung over it for concealment.

George Rutkoski, Newark, N. J.



Fun with INK PICTURES

1

By Lloyd E. Keller

Fascinating ink pictures that will amuse youngsters for hours at a time can be made easily by the children themselves with a few simple articles that are found in every home. However, before starting to make the pictures, it is well to cover the table to be used with old wrapping paper or newspapers so that any ink which might be spilled accidentally will not mar the finish. If available, an old piece of oilcloth makes an ideal cover. The materials needed are several medicine droppers, as many kinds of colored ink as are available, and sheets of white and colored paper. Don't use paper that is too absorbent or too slick. The paper is folded as in Fig. 2 and several drops of ink are placed in the crease, Fig. 1. The paper is again folded on the crease and the ink is formed into patterns by running the fingers over the outside of the sheet. When it is opened, Fig. 3, the finished picture can be seen. Some of the pictures may resemble an animal or article of everyday life, while others may look like creatures from another world. A greater variety is achieved by using several colors of inks. For example, red and green ink could be dropped on one sheet to make a two-colored picture. When using several colors, care should be taken that they do not run together and neutralize each other, as would occur when certain kinds of ink are used. Each new picture will differ somewhat from the ones that have been made, and this will hold the child's interest.

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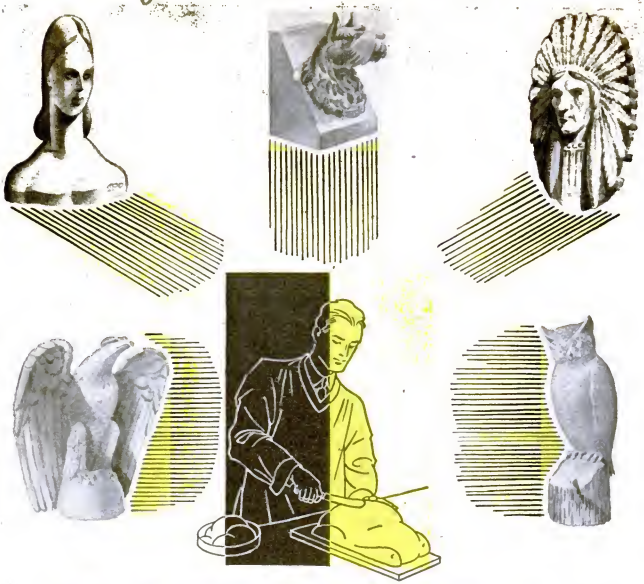


PLASTER CASTING

Using liquid rubber to form the mold is something special in a plaster-casting process. Paint it on the pattern, strip it off, and there's your mold. It's as simple as that and the reason industrial designers use it is that rubber captures the finest details worked into the original pattern

STATUETTES, plaques, shelf novelties and experimental designs for new products can easily be worked out by the plaster-casting process, using liquid rubber as a mold. The process starts with a pattern or "slip" made from modeling clay. This material can be worked into almost any desired shape with the hands, and fine detail can be modeled into the surface with modeling tools as in Fig. 2. In forming the pattern of any large object you first put together a wood core which is roughly the shape of the finished product, but smaller in all dimensions so that a layer of modeling clay can be applied over it. The core is mounted on a baseboard as in Fig. 1 so that it may be handled easily. Here a pattern is being made of a streamlined automobile body and this is used as an example of the work throughout the series of photos illustrating the various steps. Once modeling clay is applied as in Fig. 1, and worked down to a fairly uniform thickness over the core, you begin work with the modeling tools. The big thing about modeling clay is that it allows plenty of latitude for trial and error. There's no need to hurry, for the clay retains a certain amount of plasticity. So if you scrape off a little too much in shaping a window, an eye, an ear or a nose, just stick some more of the clay back in place, smooth it into the contours with

your finger and try again. Even a beginner can turn out a creditable job of modeling such an object as the car body after a little experimentation in working with the material and tools. Modeling facial features, of course, is an art and one attempts such advanced projects as statuettes, plaques or other work requiring the modeling of faces and figures only after considerable experience. In modeling an object such as the car body you learn right away to depend on your eye to tell you whether things are progressing properly or not. If a fender is off center or a window frame lopsided, your eye will catch it immediately.

In Fig. 2 the clay pattern is nearly finished and, after a few more smoothing touches here and there, the next step is shown in Fig. 3. Here the pattern is being dusted with talcum powder which serves as a parting between the pattern and the rubber mold, just as does parting sand in the foundry process of sand molding. Be sure to cover all parts of the pattern with talcum. Thus prepared, the pattern is ready to take the coating of liquid molding rubber. If the object is small this can be applied by dipping several times in the liquid. Only a certain amount of the rubber will adhere to the pattern at each dipping, hence the process must be repeated until the coating is at least ⅛ in. thick. Allow each coat to dry. Molding rubber must be applied to the larger patterns with

a brush as in Fig. 4. Use a fine-haired brush about 1 in. wide, lay the material on in quick, short strokes and be sure to cover all areas to a uniform thickness. Look out for bubbles, especially in the first coat. If any form, eliminate them by blowing gently on the surface. In the drying intervals between coats, wash out the brush in water and keep it in a can of water to prevent any residue remaining in the brush from hardening. It takes 10 to 12 brush coats of rubber to build up to about ⅛-in. thickness. Should the size or shape of the pattern require a thicker, stiffer coating, then apply layers of cheesecloth or bandage cloth as you go along, Fig. 5. In most cases it is better to apply five to six coats of liquid rubber before reinforcing with cloth.

After the rubber has been built up to the required thickness it must be supported in a reinforcing cast or shell made from plaster of paris. This must be made so that it is easily removed from the rubber mold. If the pattern surface is undercut at several points—undercuts being places where the pattern changes contour—then the reinforcing shell must be formed in several parts. The car body shown required a three-part shell. Fig. 6 shows how the first part is built up against dams made from thin plywood cut to the contour of the body top. The dams are held in place with candle wax. Fig. 7 shows the finished half shell with the dams removed. Before the second half is applied, notches are cut into the edge of the first half as in Fig. 9 so that when completed the two parts will fit together in exact register. Notches in the first half and tongues cast in the second half show in Fig. 11. Edges of the first half are coated with rubber cement before the front piece is applied as in Fig. 8. This prevents the parts from sticking together. Finally, the second half is applied as in Fig. 10. Then you have the three pieces shown in Fig. 11. Lifting the rubber mold from the clay pattern as in Fig. 12 completes the preparation for casting the model.

Now for the actual casting. The setup is shown in Fig. 13, the rubber mold being supported inside the reinforcing shell and filled about half full of either plaster of paris or dental plaster. In this case a rough wood core is used, as you see in Fig. 13. The core is embedded in the wet plaster and centered below the top of the mold as in Fig. 14. The core should be about ½ in. smaller in each over-all dimension than the

finished model. Bore several small holes in it to give the plaster a firm key, then coat with shellac to prevent absorption of moisture. Allow the casting to harden completely, remove the rubber mold, Fig. 15, and there's your completed job as in Fig. 16. Casts made from plaster of paris can be hardened by soaking in a solution made by dissolving 1 part of alum in 6 parts of hot water. Large castings should soak 48 hours or more. Castings then may be painted any desired color by a regular procedure, first sanding smooth and applying a primer, following with as many coats of finishing material as are required to produce the quality of finish desired. A really fine finish requires careful preparation, sanding between coats and then a final rubbing down to get a smooth surface. On small castings with fine detail, spraying the finishing material gives best results. Other materials similar to wood putty may be used in place of plaster of paris or dental plaster. When dry, a casting of this material can be worked much like wood. In some cases this product can be used advantageously for the pattern as well as the final casting.

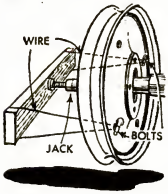
Photos courtesy Fisher Body Craftsman's Guild

How to Make Reflecting Numbers

Reflecting house numbers can be made from the metal or plastic type that are now available, or they can be cut from wood or heavy cardboard. Crumple squares of aluminum foil and then flatten them out slightly. Paste the foil over the numbers and cover the surface with several coats of clear varnish to serve as weatherproofing.

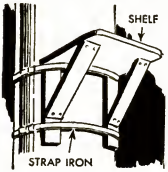
Emergency Wheel Puller for Car

If you don't have the proper tools at hand to remove the wheel from a car, you can do it with a jack if the wheel is not too tight. Fasten heavy wires to opposite points on the wheel and loop both wires over a heavy wood strip or piece of metal. Then put the base of the jack against the end of the axle and the top against the wood strip. Extending the jack will force the wheel off.



Shelf "Strapped" to Column

Where it is impractical or undesirable to use nails or screws to fasten shelves to posts or columns, strap iron can be used instead. The shelves are made as indicated and the straps are passed around the two uprights and then tightened. Wire can be used as a substitute for the strap iron. — C. A. Lecki, Cicero, Ill.



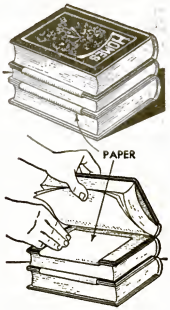
Ridge Protects Early Garden Crops

Early garden crops such as radishes and lettuce will be protected from cold wind and rain if, when the ground is prepared, a ridge of earth is pulled up to a height of 2 or 3 in. Planted on the sheltered side, the seeds will have a much better chance of maturing properly.

Sadie G. Lasley, Queen City, Mo.

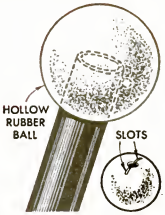
Preventing Books From Slipping

When you have to carry several books under your arm, it's difficult to do so without having them slip. If the books are stacked and a piece of paper slipped between the front cover of one and the back of the book on top, continuing in this manner for all books, you will be able to carry them easily.—D. Streby, Lancaster, Pa.



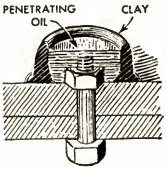
Rubber Ball Covers Gun Muzzle

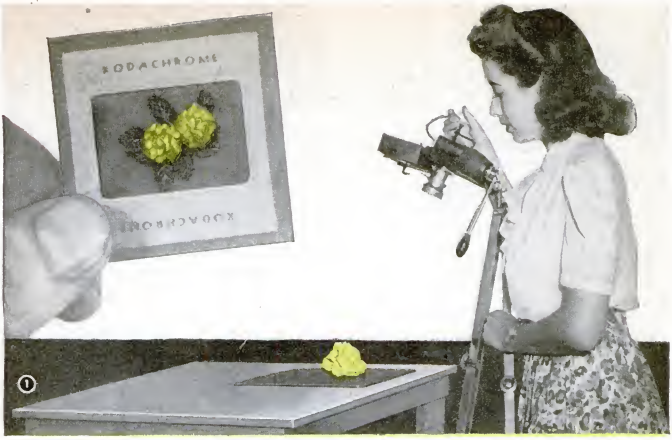
Keeping mud or snow from clogging a rifle or shotgun barrel can be accomplished by using a hollow rubber ball. Cut a small hole in the ball with slits or slots on either side. When outdoors in bad weather, slip the ball over the end of the gun. The ball should be removed as soon as you are indoors to prevent moisture accumulating inside and causing the barrel to rust. —R. A. Jenkins, St. Louis, Mo.



Dam Aids in Lubricating Bolts

Bolts that are badly rusted must be lubricated with penetrating oil for some time before the nut can be loosened. In many cases a dam of modeling clay can be built around the nut to act as a small reservoir that will retain the oil. The dam is firmly pressed in place, filled with oil and allowed to stand for several hours or overnight. — James Vick, Church Road, Va.





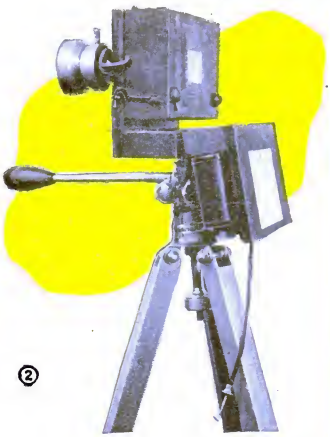
Close-ups WITH THIS FOCUSING COPY ATTACHMENT

By Robert C. Frampton

ULTIMATE solution to the problem of close-up photos with a miniature camera is the use of ground glass focusing with its accurate visual indication of both field and focus. But not many of the smaller cameras are regularly equipped with this convenience. Here is a copying attachment that makes needle-sharp focusing possible at a cost of less than $5.00. With minor changes in the dimensions it can be made to suit several makes of miniature cameras of the type having a removable tube-mounted lens. The attachment consists of three units. One holds the lens and takes the tripod screws. Hinged to it at the bottom is a second unit which holds the camera box. Hinged at the top of the first unit is the third which carries the ground glass for focusing. This latter unit swings down into focusing position as in Fig. 2, while the second hinged unit holding the camera body swings out of the way as shown. Figs. 1 and 7 show the positions reversed with the camera box back in shooting position. Parts are shown in order of assembly in Fig. 3 and are detailed in Figs. 4, 5 and 6.

First get a lens mount or adapter ring to fit your camera lens. Then make up the lens-and-tripod unit as in Fig. 6. One member should be made of ⅜-in. plywood as in Fig. 3. Bore a hole of the size indicated, or vary it to suit the adapter ring you have, and screw the latter in place. Next come the swinging friction catches, which are bent to the shape shown in the lower view, Fig. 3. It will take a little careful measurement and then perhaps a trial bend or two in order to get these catches to perform properly. As you see in Fig. 7, these hold the camera supporting unit when it is swung up into position. Notice especially how the camera unit is made. The hole through it is counterbored and this forms a light trap when the camera box is in position back of the lens. The camera box is held tightly against the opening by means of a bracket and clamp screw detailed in Fig. 5 and shown in the center view, Fig. 3. When hinging the camera unit to the lens unit be sure that the lens openings line up.

The ground-glass unit, Fig. 4, is made last. One dimension is quite important and will vary slightly with different makes of cameras. The dimension—1 29/64 in.—is, in this particular instance, equal to the distance from the front of the panel of the camera unit to the film-emulsion surface



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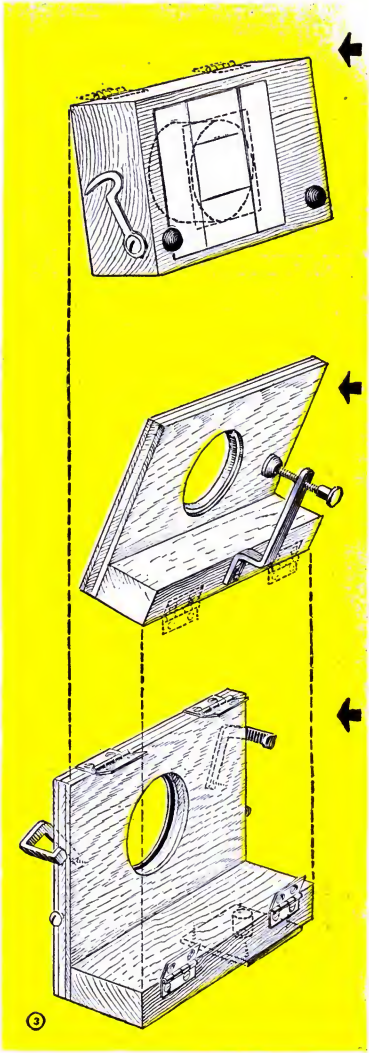
in the camera box. A shift of 1/64 in. or so in a 2-in. lens changes its focus from 18 or 20 ft. to infinity. So it's important to make sure of this dimension by using a depth-gauge reading to 1/64 in. or less. Also, the front and back faces of this part should be parallel.

Next, bore a 1⅞-in. hole through the block, locating it on the center indicated in Fig. 4. When the block is in position on the lens unit, the top edges of both units should be flush and the holes should register. Then attach hinges and hooks.

Two pieces of 2 by 2-in. lantern-slide glass are required for the ground glass although only one actually is used. The other serves as a grinding "tool." Mix abrasive powder of the grade known as "microscopic fine" with a few drops of oil and apply this to one side of one piece of glass. Then simply rub the two pieces together to produce a focusing surface. Draw diagonal lines from the corners of one glass and, with these as a guide, draw a rectangle 1 by 1½ in. to represent the picture or image area. Then center the glass over the lens opening with the ground side next to the block and with the top edge flush with the top edge of the unit. Fasten with adhesive tape. Two rubber-headed tacks, placed as in Fig. 5, protect the glass from breakage should the camera unit inadvertently be swung upward.

Now you are ready to check for correct focus and field. To check for focus, fit the camera lens on the adapter ring and, with the diaphragm wide open, set the focusing



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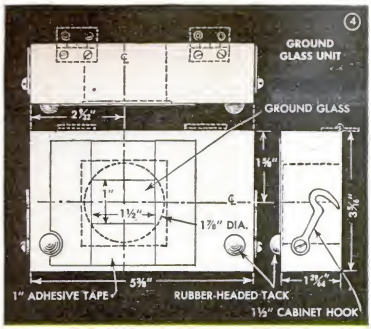
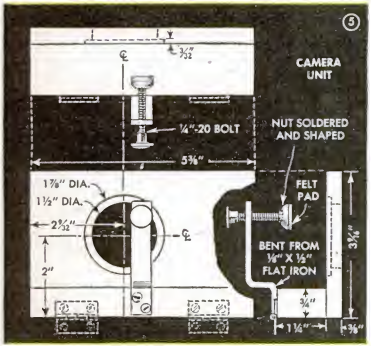
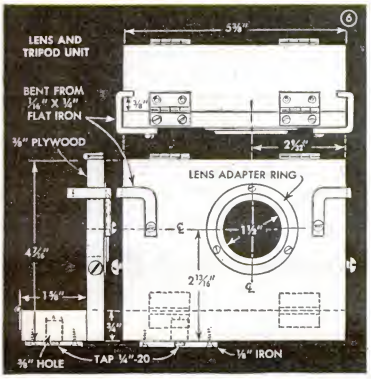
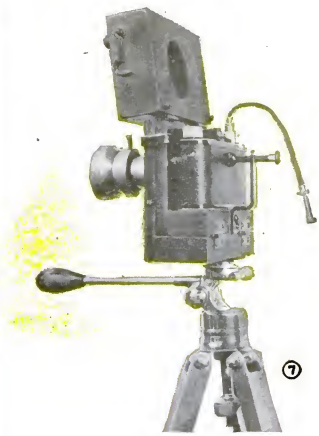








scale near the middle of its range, say about 12 ft. Load the camera and lock it in place on the camera-holder unit. Swing the ground glass unit into position as in Fig. 2. Place a magazine page about 12 in. directly in front of the lens and bring the camera into position as in Fig. 7. Make a test exposure. Then, without altering the lens setting, change the focus one division on the scale and make another exposure. Proceed in the same way until you have exposed film at four settings each way on the scale. Keep notes on each exposure.

Make 8 by 10-in. blowups from all negatives. The first should be the sharpest. But should a closer scale reading give the sharpest negative, then it's necessary to determine the amount of lens movement between the two settings. Usually this can be done by inserting a thickness gauge between the focusing scale ring and the depth of focus indicating collar. From this you can determine the difference in the two settings. Shim the ground glass back an equal distance and you have the focus corrected.

To check the field, use the same setup and mark on the magazine page the four points corresponding to the corners of the field on the ground-glass image. Enclose the rectangle with heavy ink lines and draw diagonals from the corners. Print a bold letter "T" near the top of the rectangle and then make a test exposure. With this point as a guide, it's easy to shift the ground glass slightly to correct any error in position.

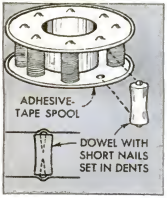
Novel Drawer Lock on Dresser Keeps Children From Prying

Children are naturally curious, and a dresser or chest of drawers is a fertile field for exploration. To keep youngsters out of the drawers, one parent connected a series of latches in such a manner that no lower drawer could be opened unless the top one, which the children could not reach, was first pulled out. The latches, as shown in the detail, were connected to a screw eye in the top drawer with a cord. Pulling out this drawer lifted all the latches.

Peter B. Horsley, Brandon, Man., Can.

Tape-Spool Holder for Thread

Here's a handy reel that will hold many different kinds of darning thread. Take an empty adhesive-tape spool and fit short dowels between the sides. These are pivoted on round nailheads that are set in dents. The dowels should be cut and sanded to have a slightly concave shape. The cover is kept on the spool to make it convenient to carry.

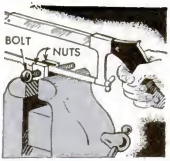


Packing Calking in Wooden Boats

Owners of wooden boats should not pack calking too tightly in the seams. When the wood swells, the screws may be pulled loose and cause the boat to leak. If a narrow space is left between the calking and the wood to allow for swelling when the boat is put in the water, it will remain dry throughout the season.

Dean K. Brown, Syracuse, N. Y.

Accurate Way to Shorten Bolts



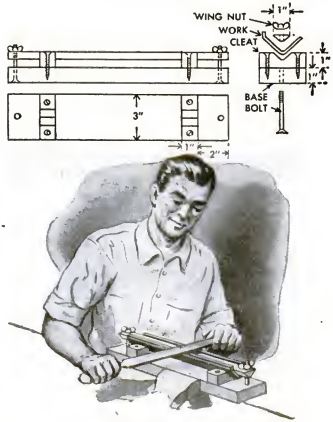
The next time you have to cut off a bolt to shorten it, try this way to secure a square end. Screw two nuts on the bolt, allowing space between them for a hacksaw blade where the bolt is to be cut. Grip the nuts in a vise and saw halfway through; then reverse and complete the cut. This assures a neat end.

H. Klein, Pittsburgh, Pa.

Small Jig Holds L-Shaped Strips While Filing and Finishing

Having a number of L-shaped pieces of sheet metal with edges that were to be filed and finished, one man made a wooden jig that held the pieces securely. The V-shaped cleats are mounted on a common base. The strip of wood that acts as a hold-down should be long enough to extend out from the work at both ends and is drilled for wing nuts and bolts. Round the 90-deg. corner of the hold-down to allow for the inner radius of the bend in the metal.

W. H. McClay, Pasadena, Calif.

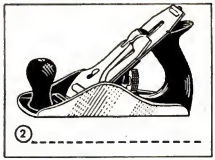


CRAFT QUIZ

11 PLANES—Can You Name Them?

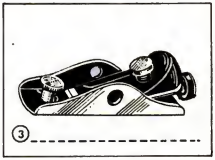
① _____

This plane is used for long work such as truing up the surface before edge-joining boards with glue



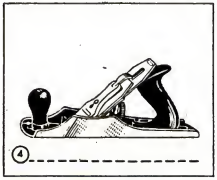
② _____

A short, finely set plane, which you can use for surface smoothing and finishing boards of all kinds



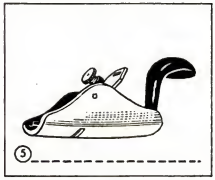
③ _____

A small plane that can be held in one hand and used for almost any light work, especially thin stock



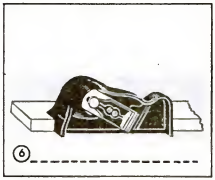
④ _____

Used to true the edges of a board as it comes from a saw. It also is used for rough-planing other work



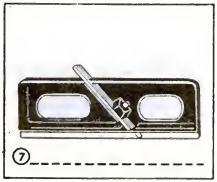
⑤ _____

Used by modelmakers, violin makers, etc. Bottom is curved upward from the center at sides and the ends



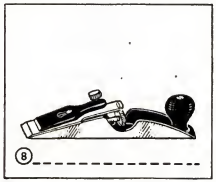
⑥ _____

For trimming or squaring the edges of boards when it is necessary to get a square or a very close fit



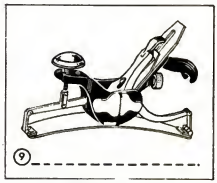
⑦ _____

Made especially for rounding corners on baseboard casings, shelves, wallboard battens and similar work



⑧ _____

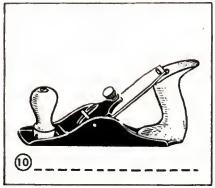
The cutting edge on this plane is located right at the front end. It is used mainly by cabinetmakers



⑨ _____

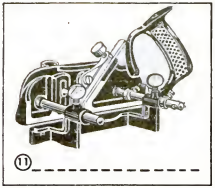
It has a flexible steel bottom and can be adjusted quickly to plane either convex or concave surfaces

ANSWERS: 1—Jointer Plane; 2—Smooth Plane; 3—Block Plane; 4—Jack Plane; 5—Modelmakers' Plane; 6—Edge-Trimming Plane; 7—Corner-Rounding Plane; 8—Cabinetmakers' Edge Plane; 9—Circular Plane; 10—Scrub Plane; 11—Rabbet Plane



⑩ _____

Ideal for use when there is quite a bit of wood to remove but not enough to warrant use of rip saw



⑪ _____

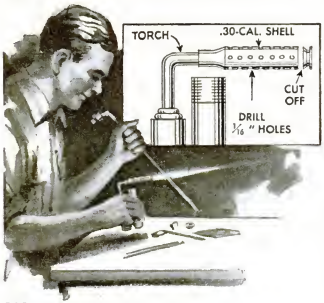
Used to make rabbet cuts in almost any kind of straight work. It has an adjustable fence for guiding it

Extension Handle on Wood Spoon Is Convenient for Campers

Steam rising from that simmering stew won't burn your hand if you stir the food with a spoon that has an extension handle. Too, with this handle, the spoon won't take much space in your duffel. Make a brass ferrule to fit the cut-down handle and use an extension that fits the ferrule.

Alteration of Alcohol Blowtorch Increases Heating Capacity

It's possible to "step up" the heating capacity of an automatic alcohol blowtorch by fitting the nozzle with an extension. A .30-cal. shell that has been fired is used for this purpose. The head of the shell is cut off and the neck is expanded to be a tight fit over the nozzle of the torch. Then



1/16-in. holes are drilled at regular intervals, and the altered unit is ready for use.

Jon Matlog, Portsmouth, N. H.

Easy Way to Start Small Nuts In Inaccessible Places

When you wish to start a small nut in a place that is difficult to reach, merely sharpen a long wood dowel at one end so that the nut can be partly screwed onto it. Then you can reach inside any small opening and start the nut without difficulty by using the dowel as a screwdriver.

Opener Serves as Tack Remover

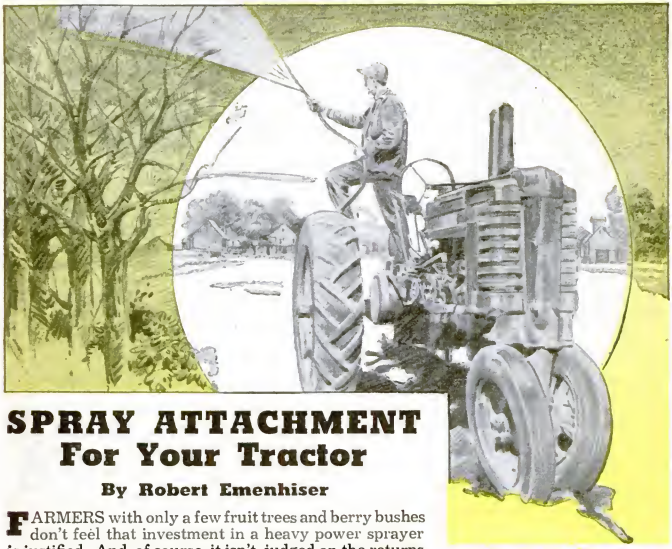
If you do not have the proper tool at hand, a common type of can opener can be used to remove thumb and carpet tacks that have been driven in too far. Grind the point down and file a V-notch so there are two points. File the ends so they will slip under a tack. You will find the tack remover will still serve as a can opener.

Ear Syringe Applies Liquid Glue

For rapid application of liquid glue, an ear syringe can be used to advantage. The tip is cut as shown in the upper left-hand detail so that it will fit into narrow joints and corners better than a brush and do a neater job. After use the syringe should be washed thoroughly. — Arthur P. Warner, New Haven, Conn.

¶Instead of breaking a glass toy bank to get the coins out, just invert the bank and insert a hacksaw blade in the coin slot. By manipulating the blade, the coins can be made to slide out along the blade.

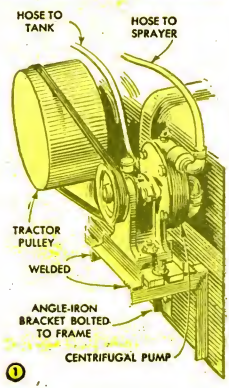
Shop Notes



SPRAY ATTACHMENT For Your Tractor

By Robert Emenhiser

FARMERS with only a few fruit trees and berry bushes don't feel that investment in a heavy power sprayer is justified. And, of course, it isn't, judged on the returns from the outlay. But the bugs and various scales that attack fruit trees and shrubs don't bother with any such practical considerations. They can ruin a valuable fruit or shade tree or a row of prized berry bushes in a single season if you give them half a chance. So far there seems only one effective control—spray and more spray, applied at the right time. And on the farm, with other work always waiting, spraying must be done as quickly and effectively as possible. By making use of the farm tractor and a small centrifugal pump you can put together a mobile spray unit with a reach of 30 to 40 ft. and sufficient pressure at the nozzle to give the proper spread. As most farm tractors of the "tricycle" or cultivating type are fitted with side frames so that you can mount implements or other attachments on either or both sides, it's easy to attach brackets and mount a small centrifugal pump on the belt-pulley side and take power from the pulley with a V-belt as in Fig. 1. Then on the back of the tractor you mount a 55-gal. oil drum to serve as a tank. Run a suction hose from the tank to the pump and another of convenient length to a spray nozzle. Fit it with a brass extension if you want to get up high in tall trees, and you have a simple spray rig that will do efficient work.



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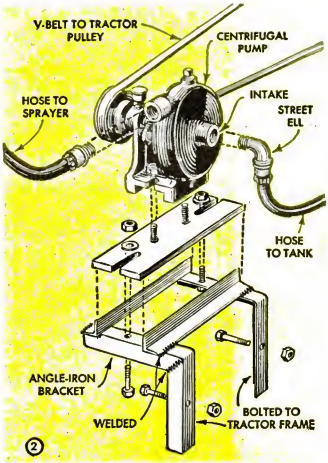


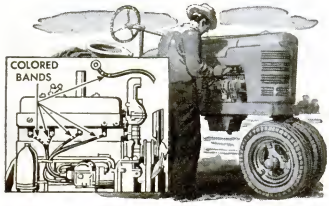
Use any small centrifugal pump with a ¾-in. intake and ½-in. discharge. Weld a hose connection to the 55-gal. steel tank ¾ in. above the bottom and connect the pump to the tank with ordinary garden hose

Brackets to mount the pump on the tractor frame can be made from angle iron as in Fig. 2. No dimensions of these parts are given because sizes depend on what pump you use and what tractor it is mounted on. Any small centrifugal pump with a ¾-in. intake and ½-in. discharge will serve the purpose. Use ordinary garden hose between the tank and the pump intake. Weld a garden-hose connector on the side of the oil drum ¾ in. above the bottom. If you strain the spray material before pouring in the tank, it will not be necessary to fit a strainer screen. Use spray hose between the pump and nozzle. Any spray nozzle with a hand-operated shutoff valve will do. Or an ordinary garden spray nozzle with a snap-action adjustment may be used. No by-pass valve is needed unless you shut off the spray at the nozzle frequently with the pump running. It is usually easier to throw out the tractor clutch and stop the pump, whenever necessary, than it is to install a by-pass valve.

Pressure at the nozzle will vary with the speed of the tractor engine. The higher the speed, the greater the pressure. The pump pulley should be about ⅓ the diameter of the tractor belt pulley. Small centrifugal pumps usually deliver greatest efficiency at fairly high speeds, and by using a small pulley on the pump it won't be necessary to race the tractor engine.

Automobile Wheel Used to Pull Posts With Aid of Tractor

With an auto wheel, a plank and a length of chain, fence posts are pulled easily, using a tractor as motive power. The chain is hooked to the post near the ground and passed over the wheel. The other end of the chain is hitched to the tractor. The chain should be long enough to prevent the top end of the post striking the driver.—Paul Criton, Kayville, Sask., Can.

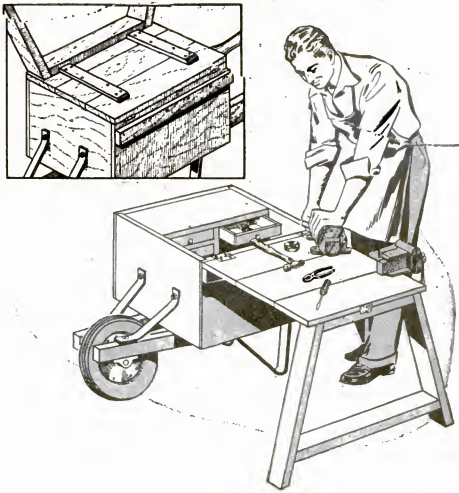


Colored Bands on Ignition Cables Helps Identify Them

When several ignition cables have been removed from the spark plugs on a tractor, it is always a problem to reconnect them. One farmer identified the cables by painting colored bands around them. One band was for the plug nearest the radiator, two bands indicated the second plug and so on. Then any number of cables could be removed without wasting time tagging them.

Portable Bench an Aid in Maintenance Work

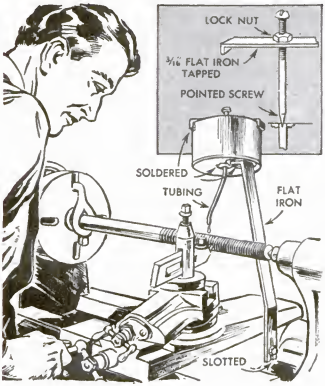
When doing maintenance work around a shop, especially where the work covers a large area, such as a factory, this portable workbench will save many trips back and forth to obtain materials and tools. It is made from the chassis of a wheelbarrow, preferably a rubber-tired one that will move over concrete floors easily. The box for tools and supplies rests on the chassis and can be connected to it in the same manner that the body of the barrow was fastened. The lid of the box opens out to form the working area and the outer edge has legs that must be rigid enough to support the table. A hasp and padlock for the lid will protect the tools when the unit is not in use. The vise is removed when the workbench is closed.



Oiler Fastened on Cross Slide Follows the Lathe Tool

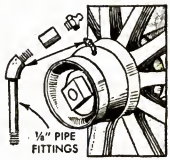
Easily made, this automatic oiler is attached to the lathe cross slide and "meters" the flow of cutting oil to timed drops, thus preventing flooding and waste. The body of the oiler is cut from a can and the tubing that directs the flow of oil onto the work is soldered to the bottom and bent so the end is over the work. Support for the reservoir is a strip of flat iron soldered to the can and slotted at the other end to slip over a bolt in the cross slide. A small strip of flat iron is soldered to the top of the can and tapped for a screw which is fitted with a lock nut. The end of the screw is filed to a point and it is adjusted like a needle valve to regulate the flow of the oil.

Axel E. Jensen, Horsens, Denmark.



Fitting to Grease Wagon Wheel

Instead of removing a wagon wheel to lubricate it, you can install a grease fitting in the hub and lubricate it with a grease gun. A hole is drilled through the hub to receive a 1/8-in. pipe nipple and the fitting is screwed to a 1/8-in. coupling. The nipple should be a tight fit so no grease will be lost.



Bearing 'Worked' Out of End Bell With Steel Ball and Tap

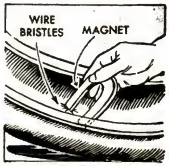
To remove a sleeve bearing from the end bell of an electric motor, one mechanic uses a steel ball and a tap. The end bell is placed on a work table and the ball dropped through the sleeve. The tap is turned into the bearing and when the end presses against the ball, continued turning forces the sleeve out. The diameter of the ball should be slightly less than the bearing, but it should not be so small that the end of the tap does not rest solidly on it.

Oil Drum Makes Handy Holder For Seed Sacks

An oil drum, cut as indicated in the detail, will make two holders for sacks of seed. Held in such containers, the sacks will not tip and the tops can be rolled for better display of the contents. Seed leaking through small holes in the sacks will be caught in the metal holders. Handles are welded to the top rim of the holder.

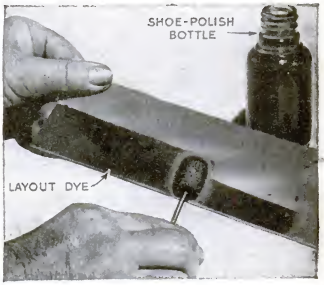
Opie Read, Jr., Chicago.

Metal Particles Easily Removed From Auto-Tire Casing



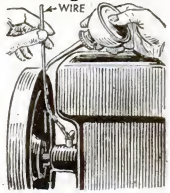
If the inside of a tire casing is buffed with a wire brush, bristles are apt to break off and lodge in the rubber, later causing damage to the inner tube. To prevent this, pass a magnet over the inner surface of the casing to pick up the bristle pieces. A fairly strong magnet should be used.

Layout Dye Kept in Polish Bottle Is Convenient to Handle



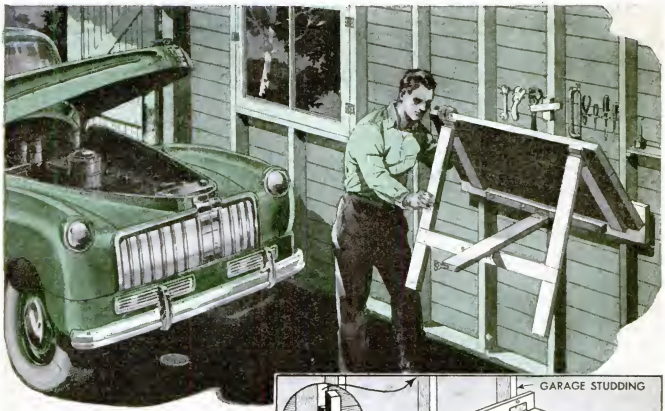
Layout dye for template and pattern work is handled conveniently if kept in a shoe-polish bottle. The dauber-type stopper makes it easy to apply and also prevents the contents from evaporating when not in use.

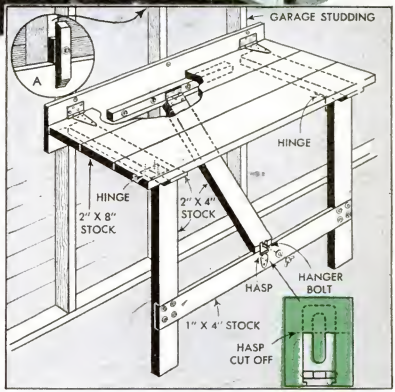
Wire Aids When Oiling Machine



Bent to fit around obstructions, a short length of wire is used to lubricate hard-to-get-at oil holes. The end of the wire is placed in the hole and the lubricant flows along it.

Folding Workbench in the Garage Saves Space

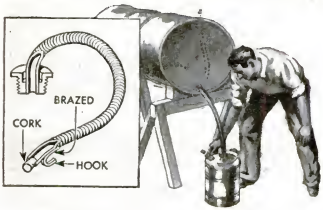




By Daniel Hyland

Not having enough space elsewhere, one craftsman made a folding workbench in his garage that proved satisfactory and when folded left plenty of room for a car. The back of the bench, which is 2 by 8-in. stock, is screwed to the studding and a brace for the top is screwed to the back. As can be seen from the illustration, the top and the front legs are hinged in such a manner that the top folds against the wall and the legs fold against the top. The bench is held in the closed position by a cleat, detail A, that is screwed into the studding. The diagonal brace which extends from the back to the horizontal cross member bracing the two legs is hinged at the back and connected to the cross member with a hanger bolt and hasp, the latter having been cut as indicated in the lower right-hand detail. Squarehead bolts fasten the horizontal brace to the legs

Flexible Tubing Attached to Drum Is an Aid When Filling Containers



It won't be necessary to look high and low for a funnel when filling small containers with oil if you attach this flexible tubing to the drum. Get a plug that will fit the hole in the drum and drill it to take the tubing. Then braze the tubing to the plug and braze a wire hook to the nozzle end. When not in use, the tube is hooked over the top of the drum.

¶Hardened glue can be softened by placing a few drops of vinegar in the container.

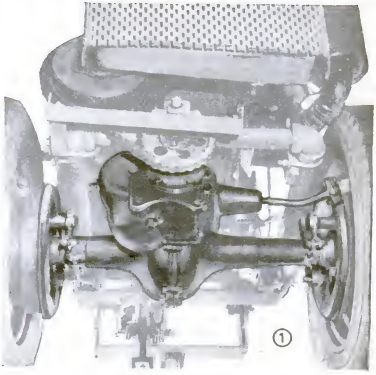
Garden Tractor

has 4-cylinder power, differential, dual transmission, starter, variable tread and hand-controlled brakes

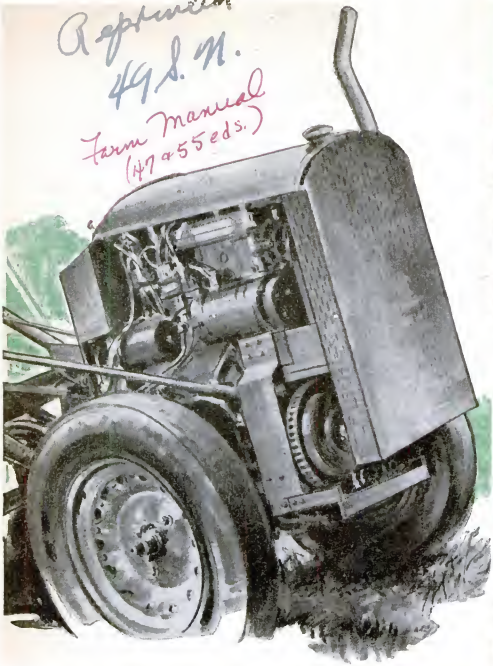
By Floyd Carlson

BUILT from a few pieces of pipe, pipe fittings and old auto parts, including the engine, this powerful garden tractor handles all the larger garden-tractor implements such as a 10 or 12-in. turning plow, 5 or 6-ft. disk harrow, any of the larger cultivators, mowing machines, etc., with plenty of power left over for the hard pulls. Because of its extra weight and compact-unit construction it's easy to handle even on the heaviest jobs. Stability and balance plus a close throttle control make it easy to steer and prevent whipping of the handles so common in the lighter garden tractors. Controls are located on the handle bars within easy reach of the operator. A heavy perforated steel grille protects the radiator core from damage in case you bump into something. Handles and frame are one unit, built up from pipe and fittings. Power is taken off the front end of the engine crankshaft by roller chain to a Harley-Davidson motorcycle transmission which contains an "over-center" clutch controlled by a lever on the handle bars. From this transmission, power is taken by roller chain to a second transmission, the latter from a Ford Model-A or 1931 Dodge automobile. This second transmission is bolted directly to a cut-down Ford Model-T rear axle as you see in Fig. 1. The "worm's eye" view in Fig. 1 gives a clear idea of the compact, efficient drive. Sounds like a cranky job to assemble, but it happens that these parts fit together with the minimum of alteration. In the process the drive pinion of the rear axle is "transplanted" to the transmission and then the two parts are "telescoped" together. A study of the exploded view in Fig. 2 will give you an idea of how these various parts are assembled. No dimensions are given on any of the parts except the size of pipe used for the frame.

The "worm's-eye" view below shows the drive. Transmission is bolted directly to the differential housing of a Ford Model-T rear axle. Brakes and hubs are from a Ford Model-A axle



Reprinted 49 S. M. Farm Manual (47 & 55 eds.)



This whole job is of such a nature that size of the parts must be determined as you go along. Much depends on what you will use the tractor for, what engine you use, whether 1931 Willys auto engine, as was used on the original, or the popular Willys Jeep engine, now so readily available. Due to variations in the mounting brackets on the Jeep engine alterations must be made from the original plan of assembly. This is not at all difficult, but will make material differences in the dimensions of certain parts.

The first thing to determine is the distance, measured both lengthwise and across the width, of the engine mounting brackets. Distance across the width of the Willys auto engine used in the original tractor was cut down to approximately 16 in. This done, you remove the clutch assembly and the clutch housing. Then make a sling from light chain and fit the chains with hooks attached to the engine in such a way that when it is raised with a tackle block the engine will hang level. Now you're ready for the rest of the job.

It's a good idea to get all the necessary material at hand before you begin work. For the handle bars you need two pieces of 1¼-in. pipe of the grade known to the trade as "extra heavy," also one piece approximately 15 in. long for

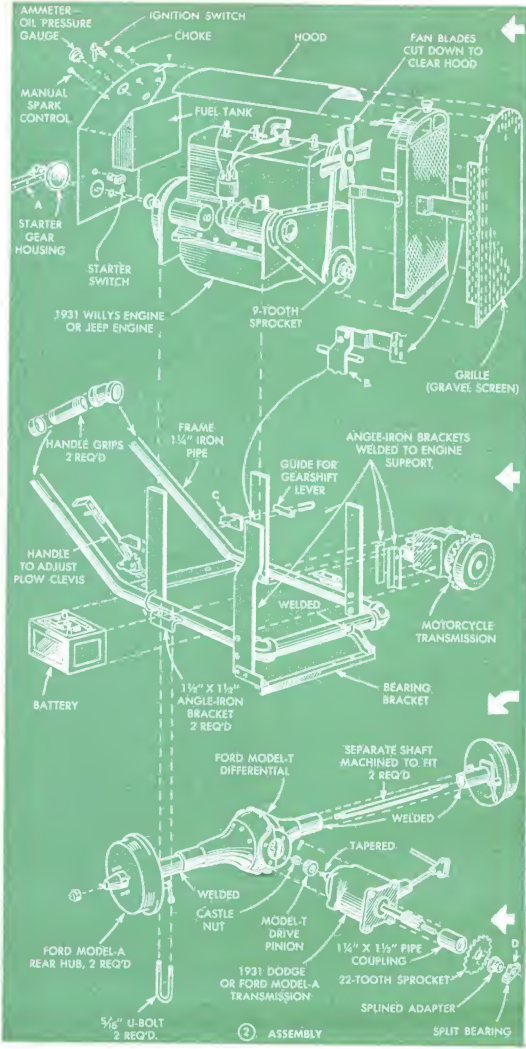
Plowing snow is another of the many jobs you'll find for this versatile and powerful tractor. With this rig it works equally well as a pint-sized bulldozer for dirt moving

the front member. Over-all width of the frame when assembled is 17 in. In addition, two 90-degree elbows, two 45-degree elbows, two 6-in. nipples and two caps are required. Then for the engine supports you require three pieces of flat steel ⅜ by 4 by 20 in. and one piece ⅜ by 4 by 22 in. long. These dimensions make considerable allowance. In addition several pieces of angle iron are needed for bearing supports, axle brackets, etc.

Next, you work on the axle assembly, shown in the lower detail, Fig. 2. Tread of the original tractor with the furrow wheel reversed was 34 in. However, the tread width depends on the work to be done with the tractor. If, for example, you plan to cultivate multiple rows of such garden truck crops as carrots or onions, then the tread width with the wheels "in" must be planned accordingly. Either way, cut up two axle assemblies to make one. You'll require one Ford Model-T rear axle complete and one Ford Model-A axle. Then, with the tread width required in mind, cut up the axle housings and reassemble the parts as shown in the lower view, Fig. 2. Machine separate axle shafts. This is a job for the local machine shop, unless, of course, you have equipment. The Model-T drive pinion and bearing are removed from the differential assembly and the pinion is mounted on the transmission as in the lower detail, Fig. 2. To do this it will be necessary to disassemble the transmission, machine a taper on the transmission shaft, also cut a thread and drill the shaft transversely for a castle nut and cotter pin. Then, to reassemble, first make a paper template of the form of the Model-T propeller-shaft mounting boss and from this scribe four evenly spaced holes on the driven end of the transmission case, keeping in mind that the transmission is turned 90 degrees as in the lower detail, Fig. 2, and also in Fig. 1. Discard the retainer ring for the end ball bearing and also the ⅛-in. spacer where the main shaft telescopes into the driveshaft. This allows the end bearing to seat flush with the end of the case. Make a washer of thin sheet metal to hold the bearing in place. Drill 21/64-in. clearance holes in the transmission case. Reassemble the main shaft and bolt the transmission case directly to the differential housing, using 5/16-in. studs, tightening nuts from inside the case. Check clearance of the pinion. It may be necessary to shim between the two parts. Then cut off the end-plate flange and weld on a 1¼ by 1½-in. pipe coupling, shown separately in Fig. 2. Cut off the transmission lever to about 8 in. long and weld on a ball-joint fitting taken from a Model-T tie rod. Later a suitable ball end is welded to the lower end of the gearshift lever which extends to the handle bars.

Assemble the frame and handle-bar unit, making a 30-degree bend in the long lengths of pipe, the bend 24 in. from the end on both pieces. Bolt the engine supports in place with 5/16-in. U-bolts. Block up the axle and frame assemblies in their relative positions under the suspended engine. Lower the engine into position and clamp or otherwise hold the parts in place. With the setup at this stage you can easily determine the location of the first transmission which bolts to one of the engine supports as in the center detail, Fig. 2. Also the location of the bearing support A, the amount of the bend in the engine support B and the location of the bracket pieces C to which the bearing support A is welded. This bearing takes the power takeoff shaft and is optional equipment. Also the position of the axle brackets shown in the center detail, and the bearing bracket which supports the bearing D. Mark the locations of all these parts. Support pieces are welded to the engine brackets and the other parts are either welded or bolted in place as shown.

Use 16-gauge sheet metal for the hood and instrument panel and also the fuel



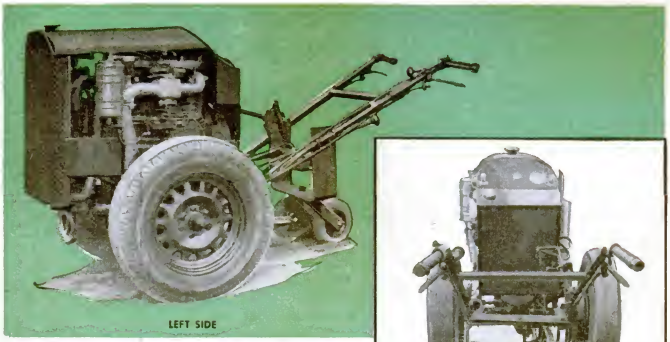
② ASSEMBLY

The power plant complete—conventional 4-cylinder auto engine with starter, lights if you want them, and the usual complement of radiator, heavy protective grille, fuel tank, instrument panel and hood—all assembled into one self-contained unit . . .

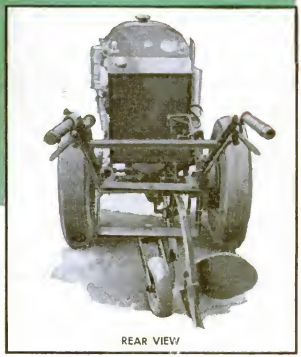
which is welded to the standing supports of the frame unit. The latter includes the first transmission as shown. Standing supports are U-bolted to the main frame. This manner of assembling permits easy removal of the power unit if necessary

Right and left braking and differential action are essential to easy operation of a "walking" tractor. This composite axle has all three features. The brakes are sufficiently powerful to lock either wheel at full load and are finger-tip controlled from the handle grips

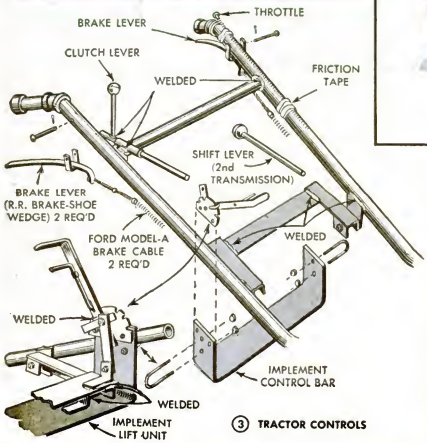
The second transmission and the axle assemble into one unit which is U-bolted to the frame in such a position that there is just enough weight at the rear to tip the tractor back on the handles when it's in the level position



LEFT SIDE



REAR VIEW



③ TRACTOR CONTROLS

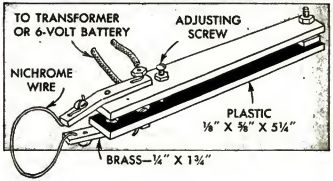
tank, which is welded to the panel as indicated. The starter-gear housing is a domed cover from a discarded gasoline pump, and is welded over the hole cut in the panel. In most cases the fan blades must be cut down to clear the hood. Radiator used on the original tractor was taken from a 1931 Willys automobile and cut down in width. Have this done by a service shop. It's also necessary in most cases to straighten the top hose connection. Do this by cutting diagonally and then soldering together to make a straight connection.

Finish the assembly by fitting sprockets as indicated and hooking up the drive chains. Bolt the grille and hood in place and attach the controls, ignition switch, oil-pressure gauge and ammeter, and wire to the battery. Increase the engine oil pressure to the maximum. Fit the carburetor with an air cleaner. Fuel feed to the carburetor is by vacuum tank, although of course a fuel pump can be fitted. Note in detail B, Fig. 2, the sleeve welded to the engine support. This serves as a bearing for the lower end of the clutch lever, which is a ½-in. rod with a short length of gear-shift lever welded on at an angle as you see in Fig. 3. A short arm welded to the clutch lever at the lower end connects to the clutch throw-out arm on the motorcycle transmission-clutch assembly by means of a short link bent from a piece of ¼-in. steel rod. Weld in a cross member about 8 in. below the handle grips to serve as a stiffener, Fig. 3. Balance of the detail in Fig. 3 is more or less optional and must be arranged to suit the implements you will use. A rubber-tired caster wheel is fitted at the center of the implement-control bar to carry the weight of certain other implements and serve as a rest when the tractor is standing idle. Use Ford wheels on the Model-A hubs. Other wheels can be used but likely it will be necessary to lengthen the studs.

Electrically Heated Wire Will Cut Glass Tubing

With a cutter like this one, which consists of a loop of electrically heated Nichrome wire fitted to a plierlike holder of hardwood or plastic, you can cut a number of lengths of glass tubing quickly. The resistance wire is taken from an electric iron, coil heater or a similar appliance. Power is supplied by a 6-volt storage battery or a toy transformer of 10-ampere capacity. In use, the loop is slipped over the tubing and pressed firmly against the glass, then current is applied for 4 or 5 seconds, after which the tube is touched to a wet cloth, causing it to break because of the sudden change in temperature. Prolonged contact with the hot wire will overheat the glass and cause it to melt.

Sam Brown, Marion, Ohio.



Tape Protects Painter's Sleeve

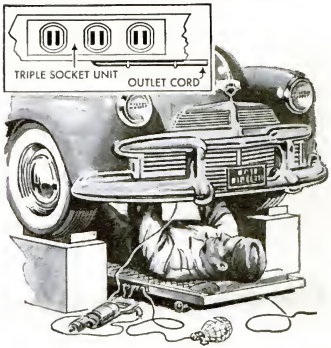
In order to prevent his sleeve from coming in contact with the finish on the car, one automobile spray painter wraps a 1-in. strip of masking tape around the cuff with the tacky side out. When removed, the tape will not stick to the sleeve. Taping the sleeve in this way also serves to keep paint off his wrist and forearm.

Dispenser Holds Artist's Brushes

Almost made to order for the purpose, a soda straw dispenser is an ideal holder for small paintbrushes that are used by commercial artists. The brushes are set in the glass in the same manner as straws, and the tips should point upward. A wood block will hold the brushes at the proper height for easy access.

Multiple-Socket Unit on Creeper Requires Less Extension Cord

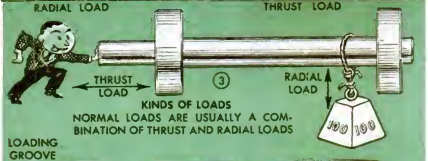
Instead of equipping his trouble light and power tools with long extension cords to reach distant outlets, one mechanic ran a power cord to a multiple outlet that was mounted on the side of his creeper. Thus, he required only short extensions on his light and power tools. The outlet box should be watertight to prevent possible shorts caused by water on the floor.



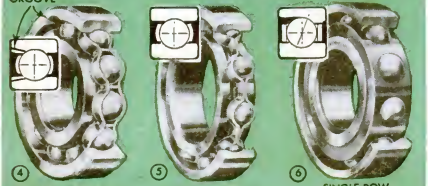
BALL

1 RADIAL LOAD

2 THRUST LOAD



3 KINDS OF LOADS
NORMAL LOADS ARE USUALLY A COMBINATION OF THRUST AND RADIAL LOADS



4 SINGLE-ROW RADIAL WITH LOADING GROOVE

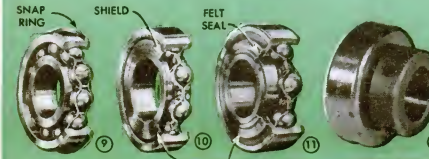
5 SINGLE-ROW RADIAL WITHOUT LOADING GROOVE

6 SINGLE-ROW ANGULAR CONTACT

7 DOUBLE-ROW ANGULAR CONTACT

8 DOUBLE-ROW SELF-ALIGNING

BEARING TYPES
FIVE OF THE MOST POPULAR TYPES ARE SHOWN ABOVE



9 10 11 12

SEALS AND SHIELDS CAN BE ON ONE OR BOTH SIDES

EXTENDED INNER RING WITH SETSCREW

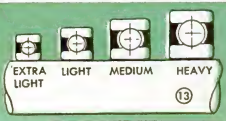
SPECIAL FEATURES

New Departure photos

By Sam Brown

BECAUSE of excellent manufacturing methods, servicing of ball bearings usually is negligible, but the time does come when a bearing may need replacement or, more often, adjustment. Also, if interested in building your own power tools, ball bearing "know how" is essential for best results.

Kinds of loads: Any bearing is subject to two kinds of loads: thrust and radial. The thrust load is a push or pull parallel with the spindle, Fig. 2; the radial load is across the spindle, Fig. 1; both types of loads are diagrammed in Fig. 3. In most power tools, the load is a combination of the two. The load in a wood lathe, for example, is primarily radial, but it can be seen that in certain operations such as boring and faceplate turning there is a thrust load as well. Some consideration must always be given the nature of the load when selecting bearings for any job.



13

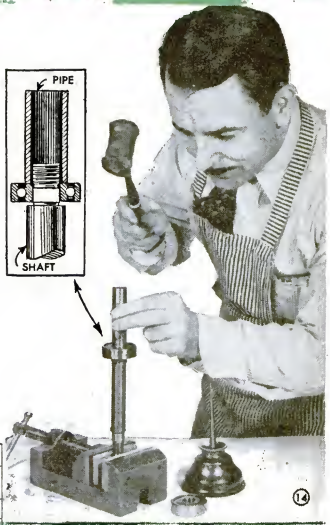
BORE SIZES		
Bore No.	Bore Size in Inches	Average Load*
0	.3937	¼ HP.
1	.4724	¼ or ½ HP.
2	.5906	¼ or ½ HP.
3	.6693	½ or ½ HP.
4	.7874	½ or ¾ HP.
5	.9843	¾ or 1 HP.
6	1.1811	¾ or 1 HP.
7	1.3780	1 or 1½ HP.
8	1.5748	1 or 1½ HP.

*HP. rating is for light series.

BEARINGS

- SELECTING
- SERVICING
- INSTALLING

Bearing types: Although there are hundreds of bearing types, selection for typical power tools usually is confined to three or four popular styles, as shown in Figs. 4 to 8. The single-row radial with loading groove or a similar device, Fig. 4, contains the maximum number of balls which can be introduced into a bearing. It is the strongest type of bearing for a pure radial load, and will also stand up under all average thrust loads. It is never used for thrust alone. The single-row radial, Fig. 5, has fewer balls, but because the outer and inner rings are continuous this bearing has higher thrust capacity. The angular-contact type, Fig. 6, is preferred for jobs where end play must be restricted. This bearing will take a maximum thrust load, but from one direction only unless it is of the type manufactured to take thrust from either direction. The double-row angular contact, Fig. 7, is used where maximum rigidity is desired. The latter is seldom used in pairs because it has practically no "give," indicating that two in tandem would re-

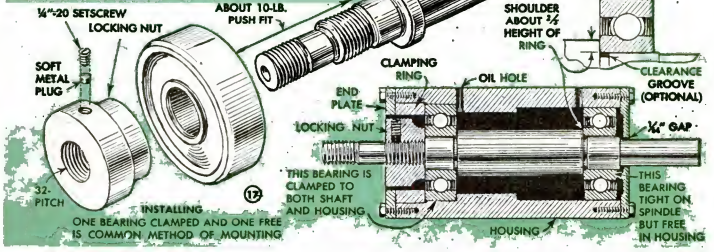


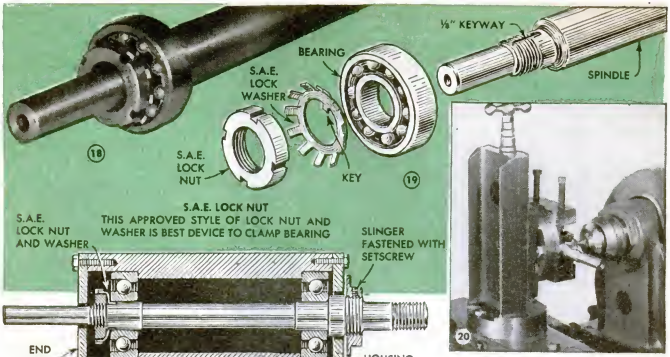
FITTING
BEARINGS SHOULD BE A PRESS FIT ON SHAFT, AND CAN BE FITTED BY DRIVING OR WITH USE OF ARBOR PRESS

HEATING
HEAT FROM 60-W. LAMP IS IDEAL FOR SHRINK FITS

(15) DRIVING SLEEVES

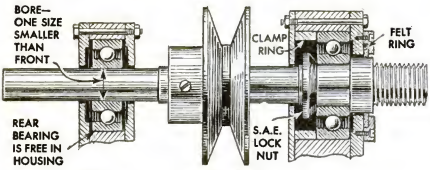
Bore No.	Standard Pipe	Tubing
0	———	½" O.D. - 18 Gauge
1	⅜"	⅝" O.D. - 1/16" Wall
2	½"	¾" O.D. - 1/16" Wall
3	———	⅞" O.D. - 3/32" Wall
4	¾"	1" O.D. - 3/32" Wall
5	1"	1¼" O.D. - ⅛" Wall
6	———	1½" O.D. - ⅛" Wall
7	1¼"	———





21 PRELOADED SPINDLE
SPINDLE MOUNTED LIKE THIS PERMITS PRELOAD AND TAKE-UP. ANGULAR CONTACT BEARINGS ARE SHOWN BUT SINGLE-ROW RADIAL CAN BE USED

22 FLOATING SPINDLE
BOTH BEARINGS ARE PRESS FIT ON SPINDLE AND PUSH FIT IN HOUSING



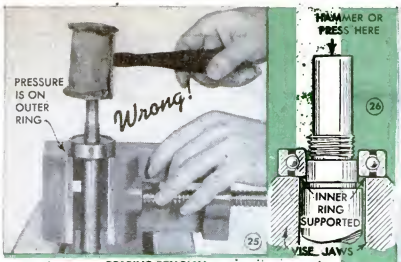
23 CENTER DRIVE
A STANDARD FORM OF INSTALLATION FOR LATHES, GRINDERS, BUFFERS, ETC.

24 SELF-ALIGNING SPINDLE
USES SELF-ALIGNING BEARINGS WITH EXTENDED INNER RING.

quire perfection in alignment when installed. However, when combined with a single-row bearing, this type makes an excellent installation for certain tools. Fig. 8 shows the double-row self-aligning type. Although rated somewhat lower than the single-row radial for any kind of load, the self-aligning feature makes it very popular with the home mechanic.

Special features: Most bearings can be obtained with a metal shield or felt seal on one or both sides, Figs. 10 and 11, the latter, the "sealed for life" type. A snap or retaining ring, Fig. 9, is sometimes useful when there is no shoulder against which the bearing can be located. An extended inner ring, Fig. 12, is a favorite with home workshoppers because it provides an easy way to clamp the bearing to the shaft.

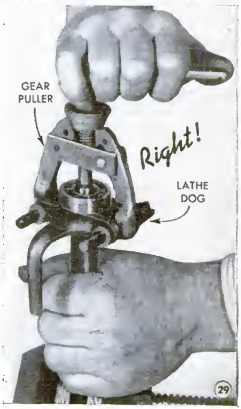
Sizes and numbering of bearings: The most-used bearing sizes for home-workshop power tools are those having bores of about ⅜ in. and up. These sizes are standardized with a system of bore numbers, of which sizes 0 to 8 are given in Fig. 13. Each bore number is made in four outer ring sizes, Fig. 13, the light and me-

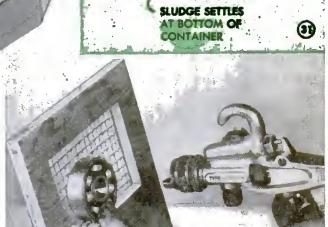


BEARING REMOVAL
ALWAYS APPLY PRESSURE THROUGH INNER RING

dium series being the most popular for all small power tools. Most manufacturers designate the light series as "200 series" and medium as "300 series." A No. 304 bearing is medium series, No. 4 bore. In practically all numbering codes, the two right-hand figures give the bore number or the bore size in millimeters. L or 1 in the third digit from the right indicates extra light series; 2 is light series; 3 is medium series; 4 is heavy series; 5 is nonloading groove light series, and 6 is nonloading groove medium series. Other numbers to the left indicate type or extra features. Small power-tool construction is mainly of the light series type. This is sturdy enough for all average loads and does not require a bulky housing. A fair guide to the selection of a suitable bore size for any power tool is the motor rating given in Fig. 13. For example, if you are making a lathe to be driven with a ¼-hp. motor, you would use No. 2 or 3 bore light series bearings. Of course, if you wanted a hollow spindle, you would have to take a bigger bore to accommodate the Morse taper.

Installation: In the basic installation, Fig. 17, both bearings are a press fit on the spindle and a push fit in the housing. The press fit should require about 50 lbs. pressure with an arbor press, or equivalent hammer taps, Fig. 14. The turning allowance for press fitting should be about .0002 or .0003 over the bore size, Fig. 13. If the bearing is held with a lock nut, as shown in Fig. 17, a press fit of about 10 lbs. is sufficient. Both bearings are a push fit in the housing, which means that they can be pushed in by hand but there should be no looseness. A study of Fig. 17 will show that one bearing is clamped to the spindle and in the housing. This bearing fixes the spindle and takes up the thrust load. The other bearing, as stated before, is a press fit on the spindle and is a push, floating fit in the housing, which allows for shaft expansion. Press-fit bearings are commonly driven on with a piece of pipe, Fig. 14. Fig. 15 suggests suitable pipe sizes for the bores of various bearings. Heat often is used to expand the bearing so that it can be pushed on by hand for a shrink fit. A 60-watt bulb, Fig. 16, gives off about 240 deg. F. heat and can be used in some cases. Immersion in an oil bath is sometimes used to heat bearings but care should be taken in either case not to use too high a heat.





CLEANING
BEARINGS SHOULD BE WELL BRUSHED WITH SOLVENT AND THEN BLOWN OUT WITH COMPRESSED AIR

The approved method of locking the fixed bearing to the spindle is the S.A.E. lock nut and washer, illustrated in Figs. 18 to 20. However, this requires a keyway, Fig. 20, which makes more work than the plain lock nut shown in Fig. 17. The S.A.E. lock nut and washer are so arranged that a 1/24 turn of the lock nut will permit engaging one of the washer prongs.

Fig. 21 shows the S.A.E. lock nut used as the take-up nut on a preloaded spindle to align the inner and outer races. In this installation, the outer rings of both bearings butt against shoulders in the housing. The lock nut is then used to squeeze the inner rings into alignment, creating a preload on the bearings. This kind of installation is particularly recommended for lathes, grinders and other tools where end play must be restricted and a rigid spindle is essential. Fig. 22 is just the opposite. Here, both bearings float in the housing, with about .015 in. end play. This installation is suitable for buffers, countershafts, motors and other jobs where end play need not be controlled exactly. Fig. 23 is a standard installation for center drive and features one bearing locked and the other floating, as previously described. Fig. 24 is a typical installation of the self-aligning bearing. A stiff circular spring is indicated as a means of taking up end play. This is optional and can be eliminated, in which case the left end plate would butt against the bearing, as does the right end. Slingers and felt rings shown in some of the installations are used to keep out dirt.

Bearing removal: Two rules govern bearing removal: keep the bearings clean, and always drive against the inner ring. It can be seen that pressure against the outer ring, Figs. 25 and 28, puts the load through the balls and may damage the bearing. Figs. 26, 27 and 29 show the right way—the inner ring is supported and takes the full force applied.

Cleaning: Surplus grease should be wiped from bearings, after which they are soaked and brushed with suitable solvent. The cleaning pan should have a wire rack, as shown in Figs. 30 and 31, to keep the bearing above the sludge. After cleaning, the bearing should be blown dry with compressed air, Fig. 32. Bearings should not be spun without lubricant since the dry condition makes them liable to scratching. Oil immediately after cleaning, especially if a drying solvent like carbon tetrachloride or alcohol is used.

Maintenance of Fence Reduced

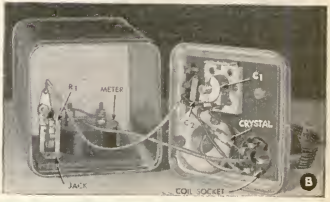
After running a strand of barbed wire directly above the woven-wire portion of the fence, instead of 3 in. above as is the general practice, one farmer found that stock did not attempt to reach through the fence. This greatly reduced the maintenance work required.

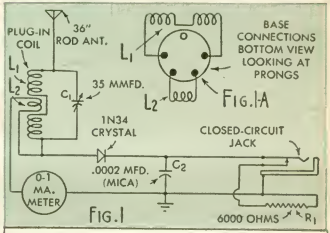
"Tea Can" Field-Strength Meter and Monitor

EVERY amateur operating in the 10, 20 and 75-meter phone bands should have some dependable means for checking the performance of his transmitter. The thoroughly tested unit illustrated employs a type 1N34 germanium fixed crystal in a combination field-strength meter, monitor and wave meter. Housed in an ordinary tea can 5 in. high and 4 in. square, it consists of an 0-1 milliammeter, a 35-mmfd. variable condenser, three 5-prong tube bases and a few odds and ends from the junk box. The rod antenna was made from three steel knitting needles; however, brass rod or stiff wire may be substituted. This rod is mounted by means of a "banana" plug and jack in a common "beehive" porcelain standoff insulator.

Photos A, B and C show various views of the completed unit; the schematic circuit diagram and parts specifications are given in Fig. 1. The 10 and 20-meter coils are self-supporting, but a 1¾-in.-long Bakelite tube form is left in the 75-meter coil. All coil terminals are soldered in the tube base prongs as shown in Fig. 1-A.

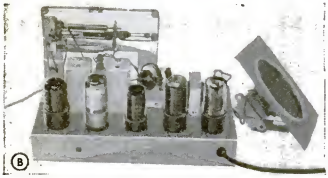
As a field-strength meter it is easy to check antenna radiation. Used for a listening monitor the quality and amount of modulation may be checked continuously while the station is on the air. It also acts as a wave meter, for a station using an electron-coupled oscillator, to check the limits of the phone band selected.





COIL WINDING CHART

L1 for 10 meters— 4 turns of No. 14 enameled wire spaced at center for L2
L2 for 10 meters— 3 turns of No. 14 enameled wire
L1 for 20 meters— 8 turns of No. 14 enameled wire spaced at center for L2
L2 for 20 meters— 3 turns of No. 14 enameled wire
L1 for 75 meters—30 turns of No. 28 enameled wire spaced at center for L2
L2 for 75 meters— 8 turns of No. 28 enameled wire
Note—All coils are wound on a form 1½ in. in diameter and mounted in a standard 5-prong tube base. The L2 coils are coupled inductively in the space provided by dividing the L1 coils.



By L. M. Dezettel

ELIMINATING the still-hard-to-get variable condenser, this 1947 model of the popular "Little Giant" student set uses a standard "Air-Com" permeability tuner unit which is the equivalent of a 2-gang variable condenser, antenna coil, oscillator coil and a 5-in. slide rule dial. This unit comes complete and is used just as received, except that the fixed oscillator coil is removed from the dial frame and mounted under the chassis base. Instead of varying a capacitance across a fixed inductance, the capacity is fixed and the inductance is varied. It is done by moving a plastic molded powdered iron core in and out of the coils. Both the antenna coil and the combination fixed-variable oscillator coil are varied simultaneously by a simple string drive mechanism.

Students and experimenters have always found something practical, and different,

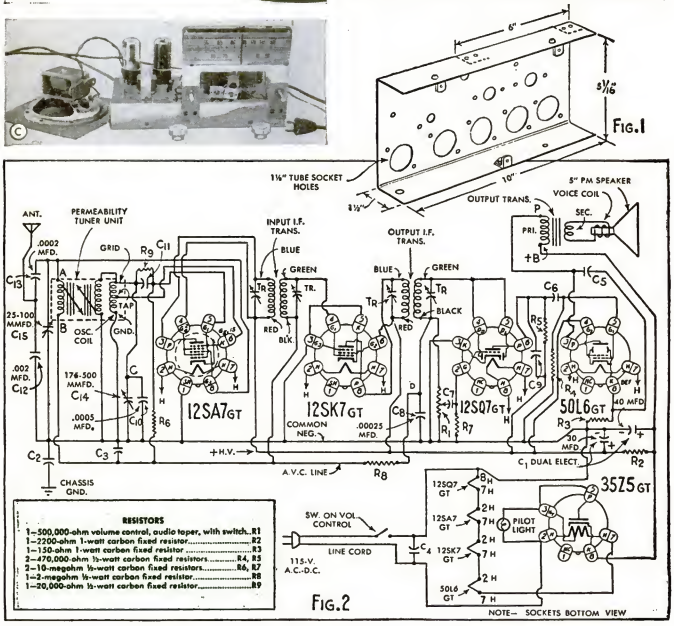


FIG. 1

FIG. 2

RESISTORS

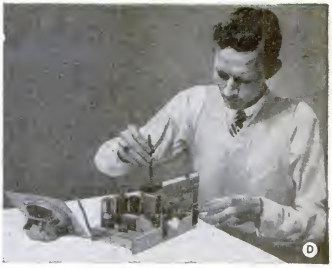
1—500,000-ohm volume control, audio taper, with switch	R1
1—2200-ohm 1-watt carbon fixed resistor	R2
1—150-ohm 1-watt carbon fixed resistor	R3
2—470,000-ohm ½-watt carbon fixed resistors	R4, R5
2—10-megohm ½-watt carbon fixed resistors	R6, R7
1—2-megohm ½-watt carbon fixed resistor	R8
1—20,000-ohm ½-watt carbon fixed resistor	R9

USES PERMEABILITY TUNING UNIT

in the March "Little Giant" broadcast receiver; this one is an excellent performer in the broadcast band, gets police calls and is easy to build. The circuit includes automatic volume control and is carefully engineered as to the values of the components selected.

Photos A, B, C, E and F show various views of the completed receiver; the chassis base, Fig. 1, is a standard type with the socket holes punched. The schematic circuit diagram is given in Fig. 2 and a detailed pictorial wiring diagram appears in Fig. 3. Any stock cabinet about 5¾ in. deep, 7 in. high and 14 in. long may be used. The pilot light bracket is bent and soldered to the center terminal of the 5-terminal tie-point strip on top of the chas-

(Continued to page 248)



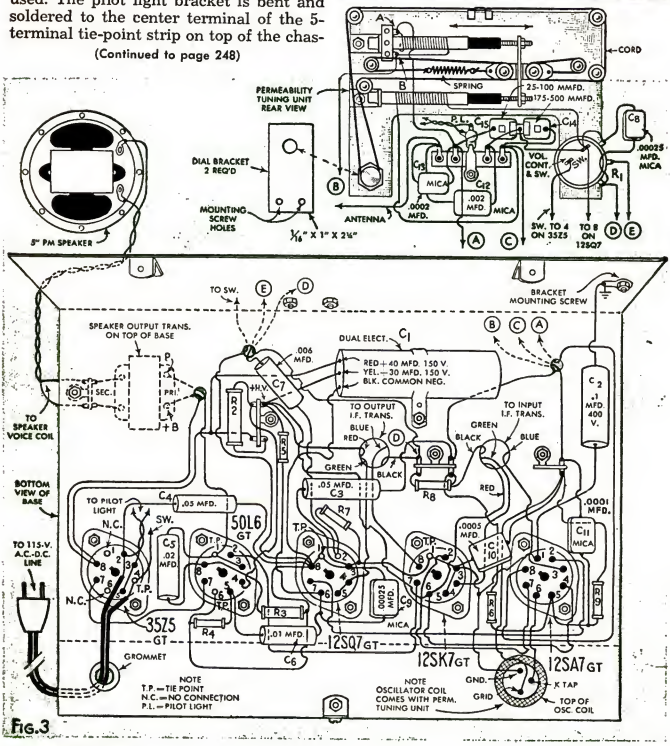
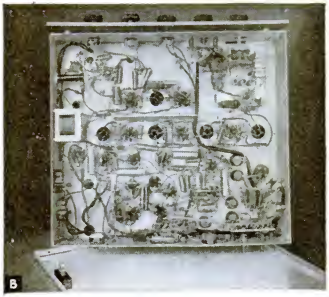
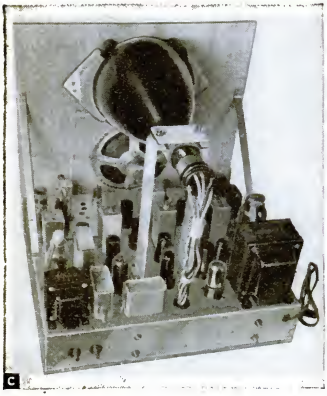


FIG. 3

Three-Channel 18-Tube Television Receiver Kit



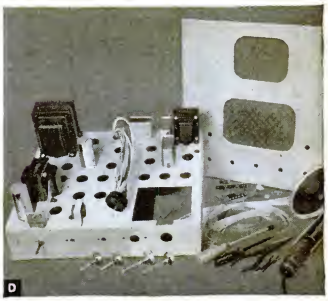


ALL necessary components are included in this television receiver kit, and it is claimed that nothing is required except a screwdriver, cutting pliers and a soldering iron to complete the assembly and place it in operation in any locality where television reception is available.

The 18 tubes include a 7-in. picture tube, and no instruments are necessary for checking as all difficult assemblies are prewired and tuned. Pretuned for any three stations desired by the user, it is said to provide a picture large enough to be viewed comfortably by 10 or more people. All wiring diagrams and directions are included with the kit.

Photo A shows a front view of the panel and controls. This panel is 18 in. high and 17½ in. wide; the distance from front to back of the chassis is 15 in. and the depth of the chassis base is 3½ in. An underside view of the chassis base appears in photo B; each component part is placed in a package and labeled with a number. An early stage in construction is shown in photo D.

This $159.50 kit is suggested for use as a trainer for schools and those interested in obtaining a knowledge of television design and servicing. It is claimed to have a newly designed sweep and synchronizing circuit and high signal sensitivity of 100 microvolts for the picture circuit. A 6-in. permanent-magnet speaker is used for good quality sound performance. Careful insulation, an interlock switch, a bottom plate under the chassis base and a ceramic cap on the high-voltage rectifier tube provide safety factors, as the second anode voltage is 3000 volts. A rear view of the completed television receiver is shown in photo C. No detail has been overlooked and a specially designed dipole antenna is included.



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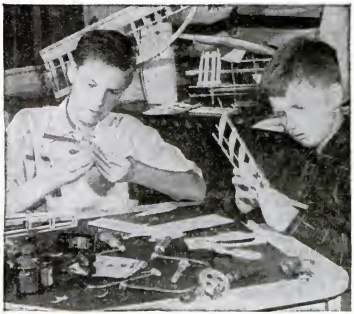
VERONICA R. STEVENS of Riverside, Illinois, made her "Paquita Dolls" hobby into a full-time business, for which she "uses X-acto tools daily and endorses them whole-heartedly."



DONNIE UHL of Great Neck, Long Island, has made more than fifty scale-model planes. He and his pal Craig Jennings say "X-acto's thought of everything a model-builder needs. That 'Big Shot' Tool Chest is swell!"

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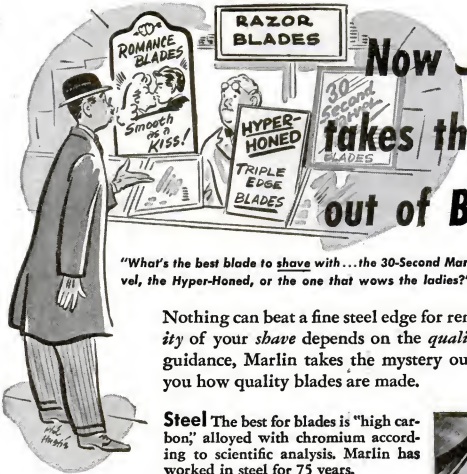

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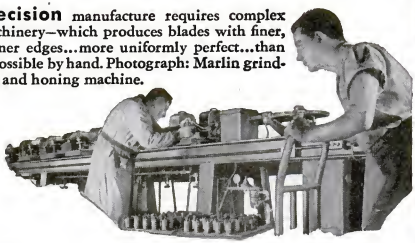

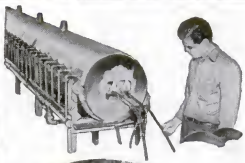

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Steel Hideaways

(Continued from page 162)

set standards which samples must meet. A Class A safe, for example, must protect material inside it through four hours of cooking in a gas furnace whose temperature reaches 2000 degrees. It also must stand up under an "explosion" test. That means popping it while cold into a preheated furnace to determine if any excess hydrogen-air-steam mixture might form. These gases could explode, rupturing the safe and spoiling its resistance to fire. Finally, the sample must undergo an impact test. The safe is heated for an hour, dropped 30 feet while red-hot onto a pile of rubble, then popped back into the furnace upside down for another hour's torture. That's comparable to a two or three-story fall when floors collapse in a burning building.

Fire-resistant safes usually have thin steel inner and outer walls with insulating material between. Protection during a blaze comes from the moisture in this insulating material. In a fire, that moisture fills the interior of the safe with steam, keeping the temperature below the point at which the contents would be destroyed.

An interesting service is being offered by a few big-city banks. It's a coin-operated day and night depository. When the bank is closed, you can do your banking by dropping a nickel in a slot. This opens a small door through which you shove a special envelope. It also automatically issues you a printed receipt. The next day the bank mails an acknowledgment for your deposit or, in the event of a withdrawal, a check as requested. You don't lose the nickel—it's credited to your account.

Modern bank vaults represent the acme of safety for your valuables. Their doors weigh from 2½ to 20 tons and provide every conceivable protection. One such

(Continued to page 244)

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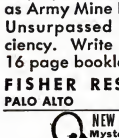

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SAM: It's a fact. I got it in 1923.

JIM: Wow! That's a long time back. Wonder if any of *my* tools will last that long.

SAM: Sure they will—if you buy the right ones to start with. I picked this wrench because it had a good name—a name I knew I could trust.

JIM: You mean that was a well-known brand even way back then?

SAM: Right. And when a reliable manufacturer puts his name on a tool—or any other hardware item—you *know* it's good.

JIM: Say, I'm going to buy some tools next pay day. How about coming along and steering me right?

SAM: I'd be glad to, Jim, but you don't need me. You know the quality brands as well as I do. And if you do your buying down at the hardware store, they won't try to sell you anything else.

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door, despite four years of Jap depredation and then American shelling during Manila's recapture, kept unharmed the assets of the Bank of the Philippine Islands. The building in which the vault stood, however, was in ruins.

Another such door guards the $12,000,000,000 worth of solid gold bricks buried at Fort Knox. And 16,500 cubic feet of granite, 4200 cubic yards of concrete, 750 tons of reinforcing steel and 670 tons of structural steel went into the building surrounding it.

Modern vaults and chests may not be absolutely burglar-proof, but they can be mighty exasperating to them. In New York not long ago some yeggs tried to break into an office safe. Unsuccessful, they tried tossing it out a window to the pavement seven floors below. It still didn't open.

Vitamin Harvest

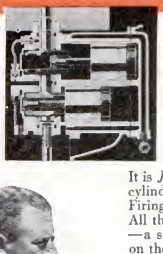
(Continued from page 149)

sporting goods store and labeled as a new species of fish. People were challenged to identify it.

The burbot is a relative of the cod, which is known solely in salt water. The presence of the burbot in fresh water is explained by the fact that untold ages ago members of the cod family were trapped inland and became landlocked. As time went on the waters became fresh instead of saline and the burbot, or landlocked cod, became a reality. Throughout the ages the burbot underwent many physical changes, some of which are different from those found in any other fresh-water fish.

The burbot (lota masculosa), also known as the lawyer, eel pout, and ling, spends the greater part of its life in the depths of the lakes. It is rarely seen or caught by sportsmen. Only in the autumn and early winter does it come inshore to feed and spawn and it is then that the commercial fishing crews get busy. The burbot is between two and three feet long, and is distinguished by brownish or yellowish spots on its catfish-colored skin. It feeds on perch, bass and wall-eyed pike. Its stomach often contains as many as 50 to 100 one-year-old perch and as many as 250 pike minnows have been found in a seven-pound burbot.

The removal of burbot from Lake of the Woods waters in great quantities has increased the number of game fish by about 50 percent. Fishing authorities are now able to put their finger on one reason for hitherto unexplained decreases in game fish. Rowell's vitamin industry is as highly praised by sportsmen as it is by medical scientists.



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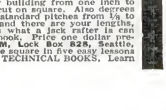

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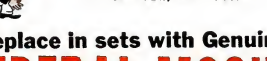
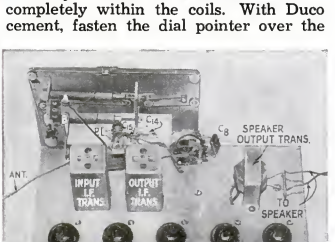


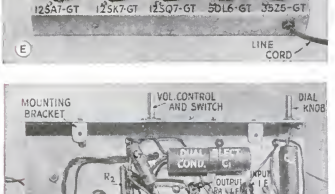
1947 "Little Giant" Super

(Continued from page 235)

sis. Solder all connections carefully with rosin core solder and keep all leads as short as possible.

The receiver should play as soon as completed; however, some adjustment will be necessary to make the tuning scale read correctly. Set the tuner so the coil cores are completely within the coils. With Duco cement, fasten the dial pointer over the





cord at the extreme left of the dial scale. Tune in a station at about 600 kc. and adjust the oscillator condenser (C14), at the same time turning the tuner knob until the station comes in at the right dial setting. Adjust the antenna condenser (C15) for maximum volume. Next adjust each of the I.F. trimmer condensers, photo D, for loudest signal. Now tune to a station at about 1400 kc. and adjust the lower coil iron core so that the dial pointer reads the proper frequency; next adjust the core of the top (antenna) coil for maximum signal strength. These last adjustments are made with the threaded brass rods in the iron cores. Detailed student material list R-353 is available from Popular Mechanics Radio and Electronics department upon receipt of ordinary letter postage.

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Putting a Show on Ice

(Continued from page 111)

able to glide through their routine four times faster than ordinary dancers. On the ice they complete in one musical count of eight the same patterns that would require four counts of eight on a ballroom floor.

Starting and stopping gracefully on skates, in unison, requires long hours of practice. Maintaining a straight line on skates also is difficult. Always the hazard of an accident is present when alternate lines of dancers are moving at top speed in opposite directions with only a few feet separating the lines. To keep in perfect form the members of the dance groups rehearse several times a week, all season long, in addition to scheduled performances.

Some ice performers use racing blades for extra speed but most of them wear standard figure skates. None needs ankle supports even after long hours on the ice because their blades are expertly fitted under their boots. Some performers weld small steel balls on the rear of their blades to avoid spiking themselves during athletic routines. Blades need resharpening twice a month and a pair of skates and boots lasts about a season.

Hockey ice is too hard, rough and slow for the flashing stunts and scintillating dance routines of an ice show. Fast ice is required, only a few degrees below freezing. Being soft, the ice scars easily under the blades and during intermissions the rink is "swept" with hot water that smooths and clears the surface.

Most large indoor rinks use an ice sheet that is only two or three inches deep. First a primary layer of water is frozen, then large templates are placed on the surface and the colors of the floor design are sprayed on, after which the templates are removed and the rink is flooded and frozen to its standard thickness.

The compact control board which operates all lighting effects was devised by George Voorhies, chief electrician. It provides 36,000 watts of illumination, and its operator never sees the show. He is prompted by a director who watches the performance and telephones his cues.

Curtains can't be lowered between acts of the ice show so blackouts are used to conceal the shifting of properties on the rink. At the conclusion of a big dance number, for example, all the lights in the house go out. Fifteen seconds later they come on to reveal an entirely different group of skaters and properties on the ice. During the period of darkness as many as 100 dancers move at

(Continued to page 256)

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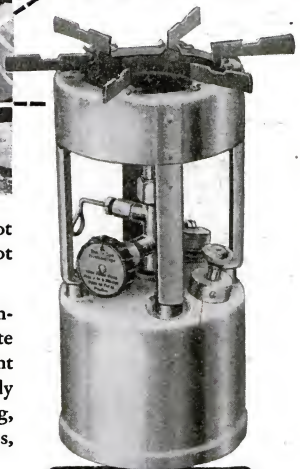

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when you have a quick-cooking Coleman Folding Camp Stove. Instant lighting. Carries like a suitcase. See it at your dealer's.

Floodlight Your Entire Camp

with a Coleman Floodlight Lantern. Its powerful brilliance makes night fishing and camp chores easier, safer. Floodlights 100-ft. area. Stormproof. Safety sealed fount can't spill fuel. Burns 20 hours for a dime. Ask your dealer for a demonstration.

FREE! Write for illustrated book telling about these and other Coleman Appliances. Address the nearest office.

Coleman
FOLDING CAMP STOVE

THE COLEMAN COMPANY, Inc., Dept. 202-PM,
Wichita 1, Kans.; 401 N. Broad St., Philadelphia 8, Pa.;
Los Angeles 54, Calif.; Honolulu, T. H.; Toronto, Can.

Coleman
FLOODLIGHT LANTERN

WESTON

Master II

EXPOSURE METER

All the science and skill necessary to take perfect pictures every time is built right into the compact WESTON Exposure Meter. Ask your dealer for a demonstration today...Weston Electrical Instrument Corporation, 671 Frelinghuysen Avenue, Newark 5, New Jersey.

"The meter most photographers use"

SAY YOU SAW IT IN POPULAR MECHANICS

PAINTERS' STRIPING TOOL

A TOOL... NOT A BRUSH

NEW, IMPROVED

Modern—streamlined—fits the hand like a fountain pen! Easy to use as a pencil. Draws parallel lines—straight, curve or circular. Does expert job on autos, furniture, toys, bikes, model planes, signs, bulletins, linoleum. (Makes wall board look like tile.) Every painter and craftsman needs one! Type "M" MASTER Painters' Striping Tool complete with tip for 1/16" stripe, $1.00. Extra tips 1/64", 1/32", 3/64", 1/16", 5/64", 3/32", 1/8"—75c each. Tool with complete set of 7 tips $5.00. (C.O.D. orders 25c extra.) Paint dealers, write!

$1.00 POST PAID

EASY AS USING A PENCIL!

WENDELL MFG. CO.
4234-B Lincoln Ave., Chicago 18, Illinois

Save with LARSON Leathercraft

For Pleasure and Profit

Send ten cents to Leathercraft Headquarters for 16-page catalog describing all necessary materials for making belts, moccasins, purses, gloves and many other practical items. Easy to assemble. Instructions come with materials.

Send for this Catalog

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176 N. Wacker Drive • Chicago 6, Illinois

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NOW AVAILABLE

America's favorite compressed air rifles for indoor or outdoor shooting are back again! Available in .22 Cal. Single Shot and Magazine Loading types. At your dealer—or order direct. Ask for Crosman SUPERPELLS too—the better ammunition for all compressed air rifles, available in .177 Cal. and .22 Cal.

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Hershey Mfg. Co., 3767 Field Bldg., Chicago 3
Please send me your free literature about Vitabrush.

Name _____ (Please Print)
Address _____
City _____ *Zone* ___ *State* ____

BE FAIR TO YOUR HAIR

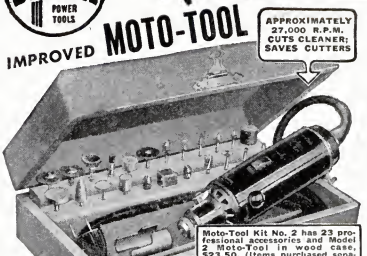
Want better looking hair? Embarrassed by falling dandruff, itching scalp? Then try VITABRUSH, the new electric driven scalp brush that gives your scalp a vigorous and invigorating "workout" in just three minutes of fun. Cleans the scalp. Stimulates the blood supply. Restful. Pleasant. Write *today* for complete information and money back satisfaction-guaranteed trial offer. Hershey Mfg. Co., 3767 Field Building, Chicago 3, Ill.

ELECTRIC DREMEL POWER TOOLS

OWN A "POCKET SIZE" MACHINE SHOP

IMPROVED MOTO-TOOL

APPROXIMATELY 27,000 R.P.M. CUTS CLEANER; SAVES CUTTERS



Moto-Tool Kit No. 2 has 23 professional accessories and Model 2 Moto-Tool in wood case, $23.50. (Items purchased separately would cost about $30.00; you save $6.50). Moto-Tool No. 2 with one emery point $16.50

"MAN...WHAT A POWERHOUSE!"

A TOOL THAT PACKS YEARS OF PLEASURE

Here's a tool to please a man's heart. A gleaming "powerhouse" that holds promise of endless creative hours. This "pocket-size machine shop" is a war veteran . . . used by all branches of the armed forces in far flung repair bases . . . and it helped set production records at General Electric, Westinghouse, Remington Arms, Ford and other plants. Hobby enthusiast or expert craftsman . . . first choice is Model 2 "Moto-Tool" kit, with its handsome, felt-lined, highly finished wood case . . . with rows of tools begging to be put to work. The usefulness of "Moto-Tool" for precision work is increased by two versatile attachments now available at slight additional cost (see below).

Look for These Features

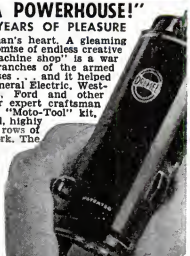
Housing has "pencil-type" finger grip; instant-action, wrenchless chuck; oil-less (sealed) bearings; patented automatic chuck-lock pin; oversize armature shaft, hardened, ground and polished; 110 volt universal type motor; easily replaced commutator brushes; sliding, snap-type switch; handy hanger hook; cord protector; sturdy, shockproof bakelite housing; dust-filtered, air-cooling system; weighs only 13 oz; shaped to fit the hand; dynamically balanced for vibrationless operation.

MONEY BACK GUARANTEE

Buy Moto-Tool and Accessories from your dealer; or order direct from factory on 10 day trial, money back guarantee.

DREMEL MFG. CO.

Dept. 117-C • Racine, Wis.



Do These Better-Faster

- ☐ Cleaning
- ☐ Rasping
- ☐ Brushing
- ☐ Dressing
- ☐ Burring
- ☐ Sanding
- ☐ Routing
- ☐ Reaming
- ☐ Drilling
- ☐ Inlaying
- ☐ Sawing
- ☐ Scoring
- ☐ Cutting
- ☐ Carving
- ☐ Sharpening
- ☐ Burnishing
- ☐ Engraving
- ☐ Touching Up
- ☐ Mortising
- ☐ Polishing
- ☐ Finishing

Free Both Hands with Moto-Tool Attachments

A. Moto-Tool Universal Stand holds Moto-Tool at any angle — $4.50.

B. Shaping Table and Stand in position to grind flat pieces to any shape. Both $7.00.

C. Shaping Table, inverted, for routing — $2.50.

It's a NEW Hull AUTOMOBILE COMPASS

• A new dress for the old reliable Hull Streamline. Now in Dark Woodgrain Brown as well as ebony satin finish, with chrome mount. Same price, $3.95. At your dealer's. Write for circular.

HULL MFG. CO., P.O. Box 246-D3, Warren, Ohio

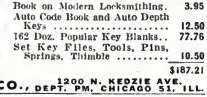
MARCOT KEY MACHINE

Immediate Delivery

Marcot No. 8 Key Machine Mounted on Cabinet	$ 82.50
Book on Modern Locksmithing	3.95
Auto Code Book and Auto Depth Keys	12.50
162 Doz. Popular Key Blanks	77.76
Set Key Files, Tools, Pins, Springs, Thimble	10.50
	$187.21

A. J. MARCOTTE CO., 1200 N. KEDZIE AVE. DEPT. PM, CHICAGO 51, ILL.

Thompson BEATS the World on BOATS



Better Built Lower Prices

Safe Boats With Full Length Spray Rails

Keep passengers perfectly dry—even at high speeds. Catalog also shows two new models of "Take-Along" Boats. Two big factories—save you freight.

CATALOG FREE

Write for your copy. State kind of boat in which you are interested.

THOMPSON BROS. BOAT MFG. CO. (151)

213 Ann St. PESHTIGO, Wis. (Write to either place) 213 Elm St. CORTLAND, N.Y.

SAY YOU SAW IT IN POPULAR MECHANICS

The KALART Compak Passive SPEED FLASH

$8.95 Complete Federal Taxes Included

Pocket size! Light weight! Built on the proven principles that have made the KALART SPEED FLASH fine famous for dependable performance. Has a specially designed "concentrating" reflector for midget bulbs. Grand for black and white—excellent for color—the Compak Passive is ideal for Kodaks, Anscos, Argus and many other popular cameras.

See the KALART Compak today at all better dealers or write KALART Dept. PM-3, Stamford, Conn. for free descriptive literature.

KALART

SENSATIONAL NEW
JET ACTION
SPEED GRINDER

ANOTHER QUALITY PRODUCT FROM THE HOUSE OF HUDSON

SHARPENS EVERYTHING FOR HOME AND SHOP
Knives, scissors, hobby tools, skates, wood planes, bits, chisels, axes and all edged tools

The HUDSON
TURBO GRINDER

Ideal for the handyman, housewife, hobbyist, mechanic. Just attach to any ordinary faucet, turn on the water and the patented Hudson Turbo-jet impeller spins the grinding wheel at 3000 to 10,000 revolutions per minute depending on pressure. Precision built throughout. Super hard silicon grinding wheel; stainless steel shaft; Chrysler oilite bearings; all metal parts chrome plated; colorful Vinylite tubing.

ONLY $8.95

FULL MONEY BACK GUARANTEE
See Your Hardware Dealer

IF YOUR DEALER DOESN'T HAVE THE HUDSON TURBO GRINDER—SEND COUPON TODAY

HUDSON PRODUCTS CO.
4403 ST. AUBIN AVENUE
DETROIT 7, MICHIGAN

HUDSON PRODUCTS CO.
4403 St. Aubin Ave., Detroit 7, Michigan
Enclosed is a $8.95 ( ) check ( ) money order for which rush to me, postpaid, one Hudson Turbo Grinder with full instructions for use. I understand the Grinder carries a full, money back guarantee.
Name .....
Address .....
City ..... State .....
Name of Hardware Dealer .....
Address .....

high speed toward the exits while others stream out to take their places. Properties and decorations, mounted on glides, are placed by skaters assigned to the tasks.

Backdrops are changed quickly with a unique roller system. The apparatus has rollers at top and bottom and the backdrop scenes are painted on a continuous strip which can be rolled up or down like a window shade. All the act-changing routines are rehearsed just as carefully as are the acts themselves. Even so, occasional collisions occur in the dark.

The Ice Follies and the other ice shows are always on the lookout for new talent. Salaries are somewhat higher than on the legitimate stage. Most of the performers are girls of from 18 to 20 years of age, chosen for their skating ability, beauty, figure and showmanship. At least four years of experience at figure skating are a requisite. New members of a group usually spend several months in rehearsal before they appear on the rink. Auditions for prospective skaters are conducted in each city in which performances are held.

This year the Ice Follies and the Icecapades are jointly sponsoring a new junior ice show, the Icecycles, as a talent farm for the parent shows. The Icecycles are barnstorming across country on routes not covered by the other shows. Including attendance figures of the Icecapades and Sonja Henie's troupe, about 7,000,000 people applaud the spectacles on ice every year.

Big Business in Dudes

(Continued from page 146)

Today aluminum spurs are replacing the heavier steel spurs worn by many ranch riders. Aluminum bits, inlaid with silver, are replacing steel bits. Nylon lariats have appeared and many experts favor them because the springy stretch of the rope is easier on both horse and steer. Confirmed dudes who can afford it often buy fancy saddles for holiday use. A good western saddle, hand tooled and ornamented with silver, costs several hundred dollars.

As much as a quarter of a million dollars has been spent in building a luxurious guest ranch but others have been started at a cost of only a few thousands. Almost any ranch situated in a good scenic area can go into the business as a side line and make money at it. Construction need not be expensive but most vacationists prefer individual cabins and bathrooms. Reliable horses are necessary plus saddle handlers who also coach new riders and act as guides.

Vacationing dudes are reviving some of

(Continued to page 260)

Piston rings wear out, too

Piston rings are designed to "take" the wear . . . to protect your engine. When they wear out they waste oil, cause loss of power and lead to excessive cylinder wear. Fortunately, piston rings can be replaced—again and again—renewing engine protection—restoring engine performance.

So, when your car first begins to smoke, waste oil, or lose power, install Hastings Piston Rings at once. They *stop* oil-pumping, *check* cylinder wear, *restore* performance. It's the best money you can spend on your car.

HASTINGS MANUFACTURING COMPANY
Hastings, Michigan • Hastings Ltd., Toronto

LISTEN TO: "I DEAL IN CRIME"
SATURDAY NIGHTS • ABC

SPEED LINER

MFG. IN S. PAT. OFF.

Fishing Boats and Runabouts

Your DREAM BOAT!

The boat you've dreamed of owning ... a SPEED LINER. And you have seven super models from which to choose ... for fishing, fun and family pleasure. Precision-built, streamlined design ... for attractive appearance, durability, maneuverability and seaworthiness.

Place your order with your dealer now to be assured of delivery in 1947. If no dealer near you, write us.

"TROPHY" MODEL

GENERAL MARINE COMPANY
ST. JOSEPH 25, MISSOURI

MEN WELCOME SIMPLER SHAVING!

World's Most Modern Razor Wins New Friends Every Day

Mystic, Conn., Mar. 2, 1947. Everywhere in America where it's been tried, the new simpler method of shaving is winning men over. The new Enders Razor gives the world's simplest shave!

Safer, swifter, smoother shaves are assured by the Enders with its amazingly simple construction. It's all one piece—no mechanics, no gadgets. All you do is click the blade in and shave! Furthermore it doesn't clog, it's easy to clean and it stays clean. Blades are sharp and long lasting—the razor is shaped to snuggle right into your hand. Just try it—you'll like it. If your nearby store doesn't have it yet, order direct from Durham-Enders Razor Corp., Dept. 103, Mystic, Conn.

SPECIAL OFFER...RAZOR AND 5 BLADES...49¢

Durham-Enders Razor Corp., Dept. 103, Mystic, Conn.

SPECIAL HUNTER'S
COMPASS

Hunting Case, Watch Type, All Metal, Jeweled Waltham

$1.95

SPORTSMEN'S GOGGLES

White Plastic Lens and Extra green Polarizing Lens. Plastic Lens are shatterproof, Polarizing Lens a protection against reflected glare, excessive light, dust and wind. Ideal for industrial use, Motoring, skiing and all kinds of outdoor use. Value $3.50. Per pair ..... SPECIAL $1.50

Engineers All Metal Army Type Hand-Sighting

LEVELS

$2.00 PRECISION QUALITY

WHEATSTONE BRIDGES Used, in excellent condition. Mfg. by Thompson Lever Mfg. Co., Philadelphia. Value $150.00 .. SPECIAL $49.50

PUBLIC SPORT SHOPS

13 S. 16th St., Phila. 2, Pa. No COD's

TURNER

VT-73
DESK MICROPHONE

Here's the mike you want for your rig. It's got looks, it's tough, and man, oh man how it performs. It's a TURNER! Ask your dealer or write for Free Literature on other low cost Turner Microphones.

THE TURNER COMPANY
921 17th St., N.E., Cedar Rapids, Iowa

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TEMPLE PIPECRAFTERS
Temple, Pennsylvania

SOLD ONLY BY MAIL
$2 POST PAID
CASH OR C. O. D.
MONEY-BACK GUARANTEE

3 in 1 OTTAWA SAW

THE WORLD'S FASTEST.

BIG FREE BOOK

6-H. P.
EASY TO MOVE

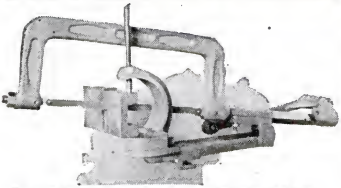
FELLS TREES,
SAWS BIG LOGS, SMALL LOGS, LIMBS

One motor performs all three operations. Furnished with or without attachments shown below. Thousands in use.

Make BIG profits in the ever increasing wood business. Pulley for belt work. Fully guaranteed. Low direct-to-user prices. FREE details—write TODAY.

OTTAWA MFG. CO., 327 Pine St., Ottawa, Kansas

Best for Reels··



LARRY POWER HACK SAW

A thoroughly tested, well designed attachment to fit the Lathe in your workshop. Saw will fit any small lathe such as Logan, Clausing, South Bend, or Atlas. The capacity of this saw is 4"x6" Length unlimited. Will cut steel, brass, etc. $19.25 F.O.B. Factory. Send for free literature.

LARRY TOOL CO., OTTUMWA, IOWA

WOOD WORKERS

LUMBER—PLYWOOD AVAILABLE

Harold Hunt wants to send new No. 15 catalog. Over 148 pages of woodworking ideas. UNEQUALED BARGAINS in imported and American woods, supplies, hard-to-find hardware. Send only 15c to cover postage and handling.

CRAFTSMAN WOOD SERVICE CO.
2729 S. Mary St., Dept. A-79, Chicago 8, Ill.

only 15¢

MASTER CHAMPION
LAWN MOWER SHARPENER

Also Mfg., Saw Sharpening & Key Machines

FRANK'S MFG. CO.
Dept. PM9
2501 E. Imperial Highway
Los Angeles 2, Calif.

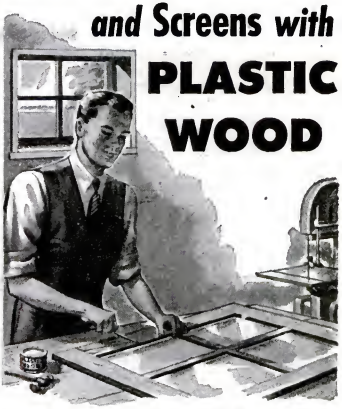
IT'S EASY PICKING
FROM A HUOT DRILL INDEX

A handy container for indexing and filing twist drills. All steel—ten sizes. Correct drill always at your fingertips.

SEND $1 for No. 13 holds drills from 1/16" to 1/4" by 64s. (Or see dealer) Order Today.

HUOT MFG. CO.
Foot, Schultz Bldg., St. Paul 1, Minn.

Repair Storm Windows *and* Screens *with* PLASTIC WOOD



When making new screens, or replacing old rusted screen, apply thin layer of PLASTIC WOOD around frame after tacking down screen. This gives greater strength to the frame. PLASTIC WOOD can be easily shaped to match broken molding. Valuable in replacing rotted wood in storm windows.

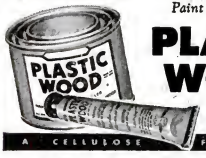
. . . dozens of other uses

FOR FILLING . . .	FOR REPAIRING . . .
• Cracks in floors	• Loose tiles
• Countersunk screws	• Loose casters
• Chipped furniture	• Broken balusters
• Nail and screw holes	• Broken furniture

• PLASTIC WOOD SOLVENT is indispensable to the home workshop hobbyist for controlling the consistency of Plastic Wood and removing dried Plastic Wood from hands and tools.

T.M. Reg. U. S. Pat. Off.

At all Hardware, Paint and 10c Stores



PLASTIC WOOD

Tube or Can

A CELLULOSE FIBRE FILLER

HOW TO MAKE ANY CAR START QUICKER—RUN BETTER

Eliminating the leakage around intake valve guides steps up compression, improves combustion. The careful mechanic uses Burd Valve Packing. Installed on *top* of valve guides, it keeps oil *in*, crankcase vapors *out*, lubricates valve stems. Its soft tension spring does not hinder valve action. The next time the head is off your engine, put in Burd Valve Packing . . . get a lot of satisfaction for just a few extra dollars. Mail the coupon for two FREE booklets described below.

BURD PISTON RING CO.
Dept. PM • Rockford, Ill.

THIS COUPON BRINGS FREE BOOKS

BURD PISTON RING CO., DEPT. PM
Rockford, Illinois
Gentlemen:
Please send me folder "Little Leaks That Run Into Big Money." Also, include FREE a copy of your "Serviceman's Handy Handbook."

Name.....
Address.....
City..... State .....

the West's ghost towns, too. These once flourishing mining communities were abandoned when the mines gave out. Situated in mountain areas, today they are next door to good fishing, hunting and hiking. Aspen, Colorado, 7800 feet high on the western slope of the Rockies, is one. In 1889, with four newspapers, streetcars and an opera house, Aspen was a silver boom town of 17,000. In 1893 the mines closed and only 700 persons stayed behind.

Today Aspen is booming again. Its old Jerome Hotel, "a model for comfort and convenience" 60 years ago, has reopened. The opera house has been restored. As much as possible the whole town is being renovated without excessive modernization. You can get to Aspen by highway or by the D. & R.G.W. Railroad which plans to carry passengers in old-fashioned coaches.

Within a 15-mile radius of Aspen are seven peaks more than 14,000 feet high as well as 13 fishing streams and more than a dozen lakes. A three-mile downhill ski run has been mapped out for winter use.

Speeding the Ocean Freight Aboard

(Continued from page 179)

the hatches can be worked simultaneously.

But at the same time he must see that the turpentine is not stowed above the cotton, as the inevitable leaking barrel would ruin many bales, and that the cheese is not put in with the turpentine and automobiles.

In loading and unloading his ship, the master also must distribute his cargo properly to maintain the stability of his vessel. In a cargo vessel the position of the center of gravity depends very largely on the disposition of the cargo and ballast. If most of the weight is low in the hold, the center of gravity will be low, and stability assured.

For this reason the ship's master uses only light-weight goods for his "on-deck" cargo. Sometimes cargo shifts in the hold during a stormy voyage, and the ship which sailed in perfect transverse equilibrium will arrive with a pronounced list.

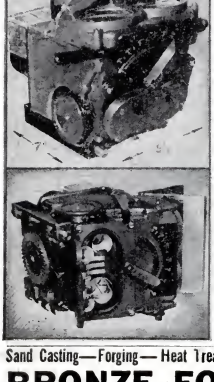
Toward the end of the war, the United States Lines conducted a stevedore school at Pier 59 in New York to teach young officers some of the "tricks of the trade" of cargo loading. A large scale model of a Liberty ship was used for the instruction.

The greatest progress in ship loading and unloading has been made on the Great Lakes in the handling of bulk ore, grain and coal. Using mechanized equipment on the piers, the modern bulk ore ship, carry-

(Continued to page 264)

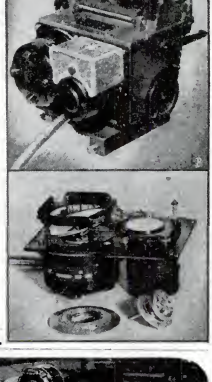
MIRACULOUS OPTICAL GYROSCOPE!

The Famous Mark 18 Gyro-sight...
New—Ready to Run—For Only $12.95!



THIS magnificent precision instrument is a triumph of Applied Physics. Its breathtaking ingenuity fascinates every engineer who sees it. **IT WORKS!** Operate this inspired aircraft gunsight that measures and computes automatically—see how sheer designing genius made gear-trains and amplifiers unnecessary. **GYRO UNIT COMES OUT** easily with all wires intact. Remove it and see how tiny ball-bearing motor's clever governor maintains constant speed from 14-22 V. ***at only 1/10 amp.*** AC or DC (no 3-phase or 400 ~ stuff!) You'll marvel at the precision-balanced gyro, its beautiful yoke and special bearings. Demonstrate how **GYRO MAINTAINS FIXED POSITION IN SPACE,** and this one has a hand figured ***spinning mirror*** supporting a perfect optical image at full speed! Energizing 6 electromagnets with DC will show erection rate or compute lead and deflections.

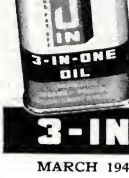
Light up the twin projection systems and see both images fuse into one. One fixed, one moving and variable, demonstrate ***virtual*** images **TWO SUPERB ACHROMATS** in threaded brass cells, cemented doublets, 2" dia. 7¼ e.f.l. ***tested perfect for telescope objectives!*** (Unusual—see instructions.) 3 Precision first surface flats, aluminized, one 2¼" x 4¼". Reflecting glass, sun filter. Two 22v. lamps in door, changeable if another voltage is desired, no rewiring. Two reticles, glass enclosed. Stainless gears. **PLASTIC GEL CELL DEHYDRATOR** with tell-tale colored silica gel. Die-cast aluminum case **HERMETICALLY SEALED.** 24" cable, 10 coded wires. Detailed instruction sheets. Detachable recoil shock base, 25-leaf spring, bronze slide on **PRECISION STAINLESS** ground rods, azimuth clamp, bolted to wood shipping base. Elegant padded cover for complete unit—brand new, original package. Cost Navy hundreds of dollars. **What a Buy at Only $12.95.** Send check or money order, no C.O.D.'s. Ship. wt. 13 lbs. Express Collect.



COLUMBO TRADING CO., Inc.
304 Canal Street, New York 13, N. Y.
25 years on Canal St.—Five Floors of bargain values.

Sand Casting—Forging—Heat Treating—Case Hardening

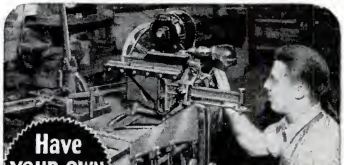
BRONZE FOUNDRY



is again available in limited quantity without priority. Orders filled in sequence as received. INVENTORS—SCHOOLS—CRAFTSMEN use FOUNDRYETTE for making castings quickly for new inventions, for instruction, and general purpose. Order now for early delivery. Three sizes are available capable of making bronze castings of 1½, 3, and 6 pounds weight, aluminum, copper, brass, etc. Domestic gas supply and 110 volt AC or DC energy required for operation.

Write for circular.

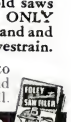
KANSAS CITY SPECIALTIES CO.
Box 6022, Dept. P-76 Kansas City, Mo.



SAW FILING

You can have a good, steady, cash business of your own reconditioning saws with the Foley Automatic Saw Filer, which makes old saws cut like new again. The Foley is the ONLY machine that files all hand saws, also band and circular saws. Easy to operate—no eyestrain.

SEND FOR FREE PLAN—shows how to start in spare time—no canvassing. Send coupon today—no salesman will call.



FOLEY *Automatic* SAW FILER

FOLEY MANUFACTURING CO.
316-7 Foley Bldg., Minneapolis 13, Minnesota
Send Free Plan on Saw Filing business, no obligation

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Life-size everyday utility vehicles for boys who love to make things with their own hands. NOT A TOY! ALL FULL SIZE, dependable, sturdy!

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9" steel-welded wheel . . . rubber tires. ALL METAL PARTS — you supply wood.

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COMPLETE metal parts. 9" steel welded, rubber tire wheels. 500 lb. capacity. You supply the wood.,

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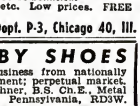

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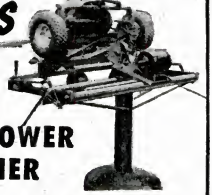

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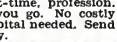

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Laminating waste stock for turning

MAKE use of your waste stock by laminating scrap pieces with CASCAMITE, because it's *strong, stain-free,* and *highly water-resistant.*

To laminate waste stock

Choose pieces of stock to roughly approximate finished size and shape. Plane surfaces to be glued so that they are perfectly smooth. Spread a thin film of CASCAMITE on the surfaces to be glued. Clamp and let set (at 70°F. or warmer) until glue is hard.

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Easy to mix. Just add CASCAMITE to cold water and stir.

Strong. CASCAMITE forms a bond stronger than the wood itself.

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Get CASCAMITE urea-resin glue—and CASCO, the standard casein household repair glue, at your hardware store in 10¢, 25¢, and larger sizes. For outdoor and boat work, use CASCOPHEN the new, completely durable, waterproof resorcinol-resin glue.

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Prevent overheating the WHIZ way!

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Among the many WHIZ favorites are these popular cooling system products: KLEEN FLUSH to clean out the rust, scale, corrosion, and sludge that clog the system and cause overheating...COMMANDO RUST PREVENTIVE to guard against the formation of new deposits and to lubricate sealed water pumps . . . INSTANT SEALER to quickly stop all leaks.

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LEADER IN MAINTENANCE CHEMICALS

ing 16,000 tons, can be loaded in eight hours or less. Performances like this have made the bulk cargo handling operations on the Great Lakes one of the miracles of water transportation.

But the methods used on the Great Lakes in handling bulk cargo cannot be applied to ocean-going vessels which handle a variety of packages, boxes and bags, and which stop at ports which often have no modern unloading facilities. For this reason, considerable thought has been given to the improvement of conventional deck gear.

High-speed electric winches have become standard for ships built under the government's long-range program. Some are equipped with 7½ and 10-ton booms in place of the customary 5-ton booms.

Among the many proposals for lowering the cost of cargo handling is the adoption of the container idea used by the railroads. The cargo, packed in wood or metal containers of identical size, would be carried in a ship with holds designed to stow the containers economically. Upon arrival at the foreign port, the containers could be lifted out more easily than uncrated cargo.

A shipbuilding company has prepared sketch plans of a proposed container ship for use on the Great Lakes, and a transportation company is considering a proposal to build three ships of the design outlined. Another company is giving the container stowage idea a trial in service.

Although the Sea Hawk experiments have already resulted in the design of a still newer type of crane gear, which is now being built, the ultimate solution to the handling of miscellaneous cargo has not yet been found. The ideal system will load and unload the vessel with greater dispatch at less cost and with reduced damage.

Newest Wonder of the World

(Continued from page 130)

lion miles, the distance that light travels in a year. The Palomar telescope, with four times the light-gathering capacity of the Mount Wilson instrument, will have a range of one billion light years and will cover eight times the volume of space that can be probed by the 100-inch instrument.

For the first time astronomers will have a telescope so powerful that some nearby stars such as Betelgeuse and Antares could be viewed as disks of light instead of pinpoints if it were not for the diffusion created by our own atmosphere. Within range of the new telescope, it is thought, will be some 10 billion star systems, each the size of our own Milky Way and each probably containing several million stars as large or many times larger than our own sun.

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PRECISION CONSTRUCTED THROUGHOUT with gears of quality hobbed steel. Gear Box housing is made of high grade aluminum alloy casting—with replaceable bronze bearings.

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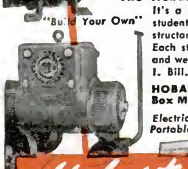

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NAME_____

ADDRESS_____

Power for the Air Age

(Continued from page 139)

is simplicity of construction and operation. The turbo unit has only a compressor, combustion chamber and turbine. Air is sucked in at the front end of the compressor, compressed and forced into the combustion chamber, where it is mixed with fuel and burned. The heated air expands and is directed in a stream against the turbine buckets, causing both turbine and compressor, on the same shaft, to revolve. This forces more air into the combustion chamber, speeding up the constant cycle. The difference between the power required to run the turbine and that developed in the chamber is the thrust power that actually drives a jet plane forward.

Along with the 10,000-horsepower engine it brings into sight, the jet boasts several other important advantages. It approximately halves the piston's one pound per horsepower weight and utilizes any hydrocarbon that will burn, including inexpensive kerosene, coal or hair oil. Initial and maintenance costs are lower, noise and vibration less and pilot operation is simpler.

The jets operate most effectively and economically at high speeds, between 90 and 100 percent of full power, while the piston begins to operate less economically above 50 to 60 percent full power. A complete jet engine transfer has been made in 14 minutes, about twice as fast as their piston competitor's best time.

On the debit side, jets have an extravagant rate of fuel consumption under 500 miles an hour. One possibility for extra thrust is a water-ethyl-alcohol injection into the combustion chamber. Any fuel cut promises sizable gains in performance and pay load, particularly in long flights, and is of prime importance in both commercial and military aviation.

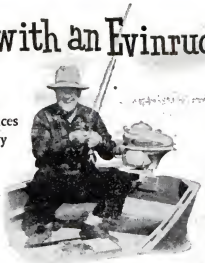
Even very slight improvements in compressor or turbine efficiency will appreciably boost net power output and cut travel time. In some instances compressors now use about two thirds or more of the power generated, leaving only a minor fraction for the all-important thrust.

Another jet drawback is the short life of turbines, subjected to heats well above 1200 degrees Fahrenheit. Chrome-nickel-cobalt alloys appear to be the most satisfactory replacement for the materials now used. Ceramic materials are also undergoing intensive trials and silver magnesium solder is regarded as another possible solution. Ways will also have to be found to screen foreign material from entering the compressor-turbine region.

(Continued to page 272)

ALL YOURS with an Evinrude

Check every quality and feature you want in a modern outboard motor . . . chances are, you'll find that Evinrude offers every one . . . *and more!* Each developed and perfected the sure and steady way . . . through 38 years of progressive engineering, experimenting, *proving*. That background is worth remembering—when you choose an outboard motor!



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Full Reverse! On two great fishing models—and new *Weedless Drive* enables you to drive through thickest weeds.

Four-cylinder Performance! Nothing like it for smoothness, thrilling responsiveness — and Evinrude offers it in three models!

Widest Range of Models! The right motor, for every boat, every service. Seven models, all with O.B.C. horsepower certification.

It all adds up to finer *performance!* And back of every Evinrude is the priceless advantage of organized, responsible, nationwide *service* . . . available everywhere through a veteran organization of selected dealers. *See your Evinrude dealer* — look for his name in your classified phone directory under "Outboard Motors". *Catalog free!* Address, EVINRUDE MOTORS, 5456 N. 27th St., Milwaukee 9, Wisconsin

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Yes, you can succeed as a manufacturer! You need no plant, no technical training. You keep your job. You invest very little money. With these 15 processes, developed and tested in the country's largest laboratories, it's easy to make products which are in great demand. For example, "Chem-Stone", a new plastic that makes concrete hard as stone and eliminates dusting; "Thermo-Sol", a new inexpensive fireproofing that has no competition; "Water Seal", the secret sealer for leaky walls and ceilings, and 12 other easy-to-make, easy-to-sell products. We supply everything you need. Get started now!

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Projects cool, bright light. 110 V. 50-60 cy. transformer illuminates automotive bulb behind condensing lens. Switch included. Two types: Model A has flexible gooseneck connection. Model B utilizes 18" rubber covered lamp cord. Price $15.00 each. Specify preference. OTHER OPTI-TOOLS AVAILABLE. FREE FOLDER!

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AIR COMPRESSORS

- ½-HP Motor 3-stage Compressor
- 4500 RPM
- Weighs 28 lbs. Boxed
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It's easy to build an attractive American Empire-style Armchair with these *actual-size* plans . . .

Stylecraft
FURNITURE DESIGNS
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Enjoy the deep-down satisfaction of producing a tasteful furniture original that can't be bought in stores

This Stylecraft design brings to the experienced craftsman an exciting adventure in woodworking!

Now you can follow actual-size plans by one of America's foremost furniture designers, to build a graceful Empire-period armchair. You do more than just copy; interesting alternate treatments suggest opportunities to express your originality without deviating from the period design.

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This new Delta original is a simple, modern interpretation of the American Empire period. Yet, it sacrifices none of the traditional richness.

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Exercise your ability on a worthwhile project you can be proud of when it is finished — a piece that enhances the beauty of your home. Construct this American Empire-style armchair.

Send today for the plans that make your job easy. The complete set is only $2.50 postpaid. Check Design No. 4205 in the coupon at the right. Then, mail it with check or money order.

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DELTA
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Name.....
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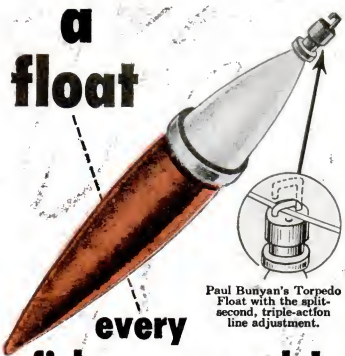
a float every fisherman needs!



Paul Bunyan's Torpedo Float with the split-second, triple-action line adjustment.

YOU'LL WANT this truly modern Torpedo Float with its triple-action head that enables you, *in a split second,* to attach or detach your line—to lock your line firmly in position desired—or to release as a free-running line for casting. And the spring-lock action is always positive, yet unharmful to the line. Its added buoyancy helps to set the hook when a fish strikes. Perfect for casting, trolling or still fishing. Designed by fishermen for fishermen. Price 75¢.

PAUL BUNYAN FLASH EYE!

Here's the old reliable "fish getter" that always gets results—Paul Bunyan's Flash Eye! Flashing transparent eyes that attract Northerns, Lake Trout, Wall-Eyes, Muskies, etc. The Flash Eye spoon comes in two finishes: copper for dark days, nickel for bright days.

Thousands of guides and men who know fishing go all out for this tantalizing killer that attracts the big ones. In two sizes priced at $1.00 and $1.10.

PAUL BUNYAN BAIT CO.
Department PM37
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If your dealer can't supply you, write us.

Within the jet family, a turbine-propeller combination is most likely to experience greatest initial popularity in the transport field, as well as in long-range fighters. One application simply calls for gearing a conventional propeller to the turbine shaft, using the excess gas for added thrust. Where operating economy is a decisive factor, this combination pairs up a lighter weight power plant with the propeller's proven efficiency below 500 miles an hour.

Propellerless turbojets, like Britain's Meteor and America's Thunderjet and Shooting Star, are predicted for early domination in the shorter-ranged fighter field. In this category, for speeds over 600 miles an hour, the propeller is a handicap.

There are two basic turbojet types, the centrifugal, or rotary, and the axial flow. Built on Whittle's original conception, the former pulls air in near the center, whirls it out toward the circumference of the compressor blades, then into the combustion chamber. The air changes direction twice before mixing with the fuel. It is shorter than the coaxial but presents a greater frontal area.

The more streamlined coaxial type brings air straight in through a series of longitudinally arranged compressor blades, compresses it and forces it right back into the combustion chamber. It has found greater favor with American designers at General Electric and Westinghouse, though a Rolls Royce centrifugal type in the Meteor holds the present world's speed mark.

Simplest and lightest of jet forms, ramjets appear to have their brightest future as a very high-speed propellant, probably for guided missiles, although their aircraft possibilities are being vigorously explored. A French design was exhibited as early as 1938. One engine under investigation by the National Advisory Committee for Aeronautics, 20 inches in diameter and weighing only 400 pounds, has a thrust equivalent to 50 horsepower per pound.

Pulsating jet engines, like those in Nazi buzzbombs, have been proposed for helicopters and as auxiliary units for conventional aircraft. In helicopter blade tips they promise very low fuel consumption.

Rockets, though operating on the jet principle, have the added ability to carry their own oxygen and operate independently of the atmosphere. This self-contained oxygen also does away with the need for inflow air scoops in the forward section of the plane, thus cutting down the drag. Also, they have a much smaller percentage of power waste than the jets.

Probably the outstanding aircraft rocket

(Continued to page 276)

Snap-on

Vacuum Grip Pliers

REG. U.S. PAT. OFF.

A complete line . . . engineered for performance

Pliers are basic tools in an extremely wide and varied range of operations. The *right pliers for the job* can make a tremendous difference in speed and workmanship. The Snap-on pliers illustrated are typical of the many types of Vacuum Grip pliers . . . each type *job-engineered* for peak performance on the work for which it is designed.

Snap-on builds Vacuum Grip pliers in a modern plant devoted exclusively to the production of the finest, most efficient pliers that can be produced. Vacuum Grip pliers are hammer forged from special high carbon chrome-silico-manganese alloy tool steel, hardened and tempered through and through. Light in weight, perfectly balanced. Smooth, easy riding joints, sharp, deeply milled teeth. Hand filed, perfectly aligned cutters. Spring-tempered, "Vacuum Grip", non-slip handles.

A famed name in Snap-on's complete line of tools for production and service, Vacuum Grip pliers are available through Snap-on's nationwide direct-to-user tool service. Write for free catalog.

SNAP-ON TOOLS CORPORATION
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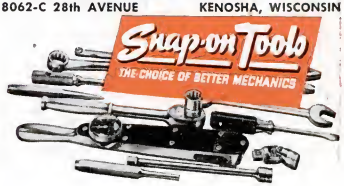

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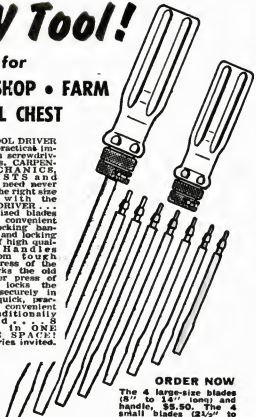

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ORDER NOW

The 4 large-size blades (8" to 14" long) and handle, $5.50. The 4 small blades (2½" to 5½" long) and handle cost $4.50. Purchase the COMPLETE COMBINATION SET of 8 blades and 2 handles for $9.50 and save. Immediate shipment, postage prepaid.

2 *HANDLES*
8 *BLADES*

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An accurate, shock-proof, water-resistant wrist watch, with radio-lite hands, numerals, and sweep second hand. Fitted with handsome leather strap. *A written and signed guarantee with each watch.* If matching stainless steel expansion band is desired, add $1.00 to your remittance. Comes to you Postage Prepaid. Send check or Money Order.

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These wheels are of best steel, with zero pressure, puncture-proof rubber tires. Lightweight, sturdy, silent. Streamline design with plenty of eye appeal.

Size 10 x 1.75 Set of 4
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Excellent for use on scooters, industrial equipment, wheel-barrows, trailers, coaster wagons, dock trucks, etc. Immediate shipment. Order now! Send check or money order.

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CUT Any SIZE HOLE TO Any DEPTH IN WOOD

Something new in wood-boring tools! Bruno Expansive Bit works like a lathe ...requires less pressure ...actually pulls itself through. Positive lock with patented triangle blade. Diamond grind on lead screw prevents splitting. Wide throat for chip clearance. Easy-to-read scale. All cutting surfaces of high grade tool steel. Replaceable blades

NOW ONLY $2.45

Wide Cutting Range!
No. 200-B cuts ¼" to 1¼" Diameter.
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Each comes with 1 long, 1 short cutter.

Money Back Guarantee At All Hardware Stores or Write Dept. PM-3

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BRUNO TOOLS 9330 SANTA MONICA BOULEVARD BEVERLY HILLS, CALIFORNIA

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Rolls like baby buggy on 4 big (Dual) 8 x 2 rubber tires. Unusually resilient, quiet. Easily handles refrigerators, and all appliances up to 800 lbs., 54" ht.; 24" nose; 13" web strap. Also handles crates, boxes, bags, etc. $31.95 f.o.b. Over 10,000 Handees trucks sold by mail. Send back express collect if not satisfied. Order Monday—get Friday, from

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BUILD YOUR OWN ROTARY TYPE LAWN MOWER

We Supply Cutting Unit Complete

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WHY PAY MORE?

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Be permanently tooled-up for *every* operation on your Metal Cutting Lathe

The ACE Set is complete—there's nothing more to buy. Drop forged by the manufacturers of cutting tools used by 95 per cent of the plants and shops in industry that are correctly designed, are of special steel, are finely finished, are stronger—will last a lifetime. You can cut easier, faster and more accurately with ACE TOOLS.

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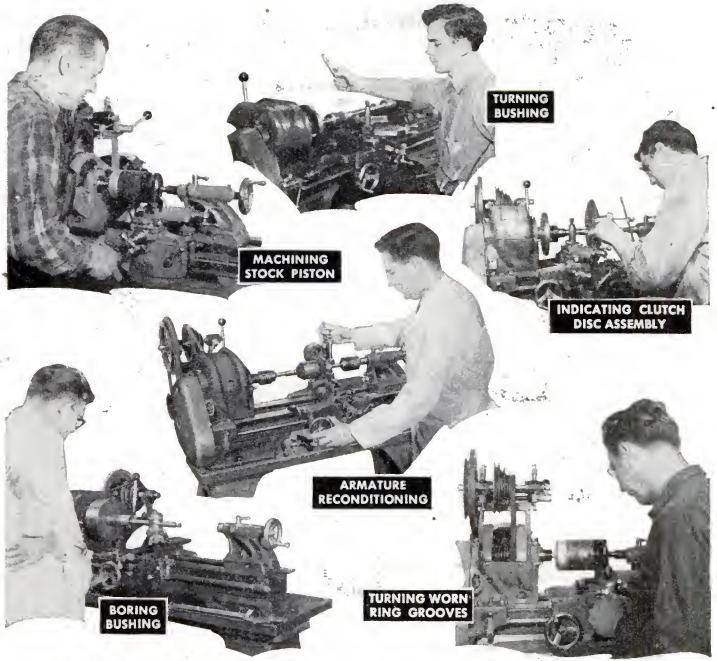

Atlas LATHES Speed Up Auto Servicing

Garages and automotive shops all over the country are rapidly equipping with Atlas lathes. It's a profit hint to consider if you operate or work in such a shop — something to remember as a valuable use for an Atlas in your home shop.

Six typical Atlas lathe servicing jobs are shown above. All told there are 44 different ways to keep an Atlas busy in modern automotive repairing.

Atlas lathes are preferred for such work because they are: (1) compactly engineered for minimum space (2) easy to set-up and operate (3) work to close tolerances (4) extremely versatile (5) ruggedly built for years of precision service (6) available at low cost.

Ask your Atlas distributor for complete details and delivered prices.

SEND FOR FREE CATALOG

Get complete information about Atlas lathes, drill presses, millers, shapers, and the many inexpensive accessories available for Atlas tools. Send for this free catalog today. Atlas Press Co., 343 North Pitcher Street, Kalamazoo 13D, Michigan.

Atlas 4 TOOL TEAM

application is the engine developed for the XS-1. Built by Reaction Motors, it is believed capable of turning up 24,000 horsepower at 1500 miles an hour, though it weighs only 210 pounds. Alcohol and water mixed, with liquid oxygen as the oxidizer, are injected into the four cylinders to burn at about 4500 degrees Fahrenheit. Cooling is accomplished by routing the alcohol-water mixture over the thin cylinder walls on the way to the burning chamber, giving the cylinders a 25-hour life.

The Germans applied the rocket principle in their ME-163 and were able to prolong the power supply to about 15 minutes. The pilot would glide for long periods between short bursts of power.

NACA scientists recently described the Tiamat rocket as the "first guided missile to be flown successfully through a predetermined program of maneuvers." Built as a flying guinea pig for future supersonic robot weapons, it is over 14 feet long, weighs more than 600 pounds and flies faster than 600 miles an hour. Data on its speed, control movements, degrees and speed of roll are relayed from instruments in the missile to the ground by telemetering.

The most glaring shortcoming of rockets, like jets, is excessive fuel consumption, although this was improved slightly in the XS-1 engine. The Nazi V-2 rocket, for instance, required about 200 pounds of propellant per second, or 8½ tons, on its highest ascents. Also, liquid oxygen is a dangerous and temperamental material to handle, as researchers have learned.

An engineering study is currently under way to explore the possibilities of an all-electric airplane. It is theorized that electric motors, driven by turbines, might offer large savings in weight and power because of more efficient propeller location and reduced drag. A 500-kilowatt auxiliary prime mover, with generator equipment and an over-all weight of less than ¾ pound per horsepower, is in the design stage.

One of the most recent exhibitions of the potentials of Diesel flight was made with a four-cylinder engine equal in weight to a conventional engine of like horsepower. For an hour's flying in a small monoplane, where a comparable piston engine would drink seven gallons of aviation gasoline, the Diesel used just over two of a fuel costing a third as much as aviation gasoline.

Indicating the serious consideration of atomic energy for aircraft power is the cooperative development program being carried on by the AAF, the Manhattan Engineering District and several plane companies. Emphasizing its importance,

(Continued to page 280)

"Me . . . a magician?"

"Honest, I'm not. I'm only a mechanic, a Doctor of Motors, perhaps *your* Doctor of Motors.

"Most of my 'patients' are broken down jalopies that have been neglected for three or four years straight. Yet, the owners expect me to wave a magic wrench and make their cars purr like next year's models!

"No, I'm not a magician but I *do* bring those cars back to life. We mechanics have had to specialize in old cars since '41. And we have learned how to make motors last—and last—and last."

Notice to Car Owners!

You can help your Doctor of Motors help your car last, merely by taking it in to him for regular care. That way he can spot troubles in advance, keep all those little troubles from becoming big ones, save you money, probably save you your car.

So see him soon and regularly. Your favorite mechanic—*your* Doctor of Motors—recommends Perfect Circle Piston Rings. They are available at every automotive repair shop.

The Perfect Circle Companies, Hagerstown, Indiana, U.S.A. and Toronto, Ontario, Canada.

Your Doctor of Motors restores power . . . saves gas . . . saves oil with . . .

PERFECT CIRCLE PISTON RINGS

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There is a difference in Hearing Aids

● A better hearing aid may help *you* enjoy life more. Western Electric Hearing Aids are the *only* ones designed by Bell Telephone Laboratories, designers of the famous Bell telephone. They are made by the nation's largest producer of communications and electronic equipment.

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TRB—S56 Precision Lathe $1000.00

MORE ACCURACY, MOST LATHE PER $

No other moderate priced lathe and but a few of the most expensive, have the "Zero Precision" tapered roller spindle bearings, have beds and ways or lead screws held to such close tolerances. In standard quality tool features, no other lathe can offer as much capacity, utility, and convenience per dollar, as you get in the new Sheldon TRB—S56.

This 11½" swing, 1" collet capacity, 56" bed precision lathe comes with full quick change gears, a full double walled apron with power longitudinal and cross feeds, 8 spindle speeds (35-1350 r. p. m.) and a fully enclosed double V-Belt underneath motor drive, mounted on a modern welded steel bench, complete, less motor for $1000.00 f.o.b. Chicago.

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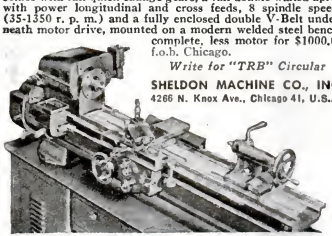

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This war proven product used by America's largest industries on machinery, equipment, walls, etc. to protect and beautify by one application. Ideal on metal, wood, brick, tile or fabric.

Dries in 2 hours! May be brushed or sprayed. Comes ready mixed. Keeps indefinitely. One gallon **CHROMELYTE** covers 700 square feet! At dealers or postpaid direct. Quart cans **$2.00**. Gallon cans **$6.00**. Satisfaction guaranteed.

USE IT ON

Boilers, Furnaces, Heaters, Stoves, Bicycles, Wagons, Trailers, Pipes, Boats, Yachts, Tents, Camping Equipment, etc.

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CECO *WHIZZ!!*

10" All-Purpose Wheel

Double Radial Ball Bearings give this wheel **speed plus!** Puncture proof balloon—10" x 1¾". Heavy duty wheels — for racers. 4 wheel trucks, wagons, market carriers, golf bag carriers, scooters, garden and porch furniture, etc., etc.

Ceco "Whizz" wheels are completely assembled: ready for immediate use. They're smooth, quiet, stream-lined, STURDY. (We have axles and other parts; ask for prices.)

Cash with order or P.P., C.O.D.
Supply limited; order today!

Dealers—Write for Quantity Prices.

$2.75 EACH COMPLETE Including Tire and Bearings Set of 4—$10.80

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WHY BREAK YOUR BACK MOWING FIELD OR LAWN?

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SAVE MONEY SAVE TIME

Now anyone can save time and effort mowing field or lawn by building their own whirl type power mower. Build according to your own ideas and needs at small cost. Cut close to fences, walks, buildings, etc. Build in short time with parts and instructions we furnish. Save hours of time and back breaking labor. Write today for FREE information.

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Profit by the Building Boom!

Start your own business manufacturing concrete building block and brick. Use Economy hand moulds. Make true, straight, easy-to-lay units which will pass any building code. Small investment, high production, big profits. One $30.00 mould will make 1,000 5"x8"x12" blocks per day. Letters and repeat orders tell how pleased our customers are.

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Hey, Fellows!

A REAL RADIO FOR ONLY $6.15

You Build It Yourself

BEGINNERS, STUDENTS! . . . Here's what you have always wanted—a low cost, foolproof, build-it-yourself radio (AC-DC) that's a top performer. Gain experience and confidence making it — fun using it. Ask for Kit R-3. Supplied less 3 inexpensive tubes, wire, solder, earphones for only **$6.15.**

Newark also offers:

A five-tube AC-DC superhet, automatic volume control, true tone reproduction, Alnico magnet in speaker — many other features. Beautiful brown or ivory cabinet included. An excellent kit. All stations on broadcast band. Ask for Kit S-5. Cost, complete, less tubes, only **$14.45.**

Short wave and regular broadcast band receiver kit. Many top features that will interest more advanced radio students and enthusiasts. Kit also includes good looking brown or ivory plastic cabinet. Ask for Kit S-6-X. Cost, less tubes **$18.95.**

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NEW YORK Offices & Warehouse 242 W. 55th St., N.Y. 19 — **NEWARK ELECTRIC COMPANY, INC.** — CHICAGO 323 W. Madison St. Chicago 6, Ill.

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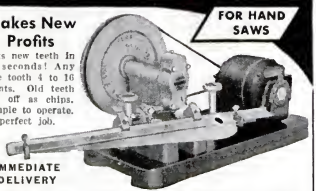
AUTOMATIC RETOOTHER

FOR HAND SAWS

Makes New Profits

Cuts new teeth in 50 seconds! Any size tooth 4 to 16 points. Old teeth fall off as chips. Simple to operate. A perfect job.



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GET THE BEST IN MUFFLERS

V-8 DUALS & SINGLES

Finest Norman custom-built muffler sets — steel pack — torpedo type — heavy, perforated steel cores — chrome enamel finish — mellow, deep tone (improves with use) — designed to fit — all ways superior — double economy.

DUALS.....**$17.50** V-8 Ford-Mercury

SINGLES.....**$7.50** Buick, Olds., Chrys.

SINGLES.....**$5.50** Chev., Ford, Plym.

ORDER TODAY! Will outlast three ordinary mufflers.

Dealers—Write Today for Full Details

NORMAN'S MUSICAL MUFFLERS

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New!

MODEL 151M

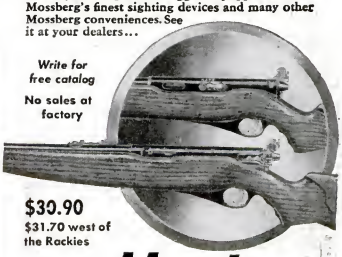
.22 Caliber

MOSSBERG AUTOMATIC

Tops in beauty, mechanical perfection and value. Embodies many new features. Shoots 15 shots as fast as you can pull the trigger. Equipped with all Mossberg's finest sighting devices and many other Mossberg conveniences. See it at your dealers...

Write for free catalog

No sales at factory



$39.90

$31.70 west of the Rockies

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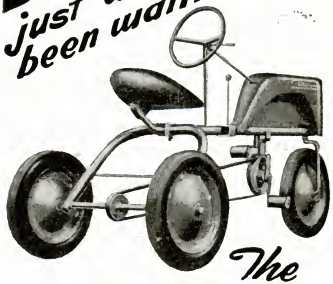
BOYS Here's just what you've been waiting for.



The Sensational

TRACTALL

A husky little giant of more fun and practical uses than any wheeled vehicle you've ever seen. New, original and fully guaranteed. Built of steel and aluminum with big oversized rubber tires on ball-bearing disk wheels.

Powered by pedal driven V-Belt. Safe, clean and non-slipping. Gearshift lever and steel steering wheel just like a regular tractor. Finished in red baked enamel.

Only by direct sale from factory is this price made possible $26.75

Use This Coupon

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BUFFALO 3, N. Y.
Ship one "TRACTALL" Express collect for which I enclose check ( ), Money order ( ) for $26.75.

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Address _____

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Product of

INLAND MFG. CORP.

158-164 ELLICOTT ST. BUFFALO 3, N. Y.

Major General Curtis E. Le May, chief of AAF research, said: "From a military standpoint the development of nuclear-powered aircraft may be as significant as the development of the atomic bomb."

It is agreed to be perfectly feasible to use atomic energy to drive a turbine, and atomic-heated hydrogen has been suggested as a rocket propellant. One of the toughest problems will be finding a shield, light and small enough for aircraft use, to protect personnel from the deadly radiation.

So with speed, range, reliability and operating economy the final arbiters in each category, the battle is on. And one sure winner is the public, who'll get there faster, surer and cheaper as a result!

Proving Ground for Gasoline

(Continued from page 93)

control the rate of acceleration of the rear wheels, makes it possible to conduct knock tests under simulated road conditions.

The temperature of the hot room can be maintained at a high of 150 degrees Fahrenheit and the cold room has been used in research on trucks at 50 below zero. The capacity of the cooling system in the cold room is sufficient to keep the temperature at zero while an automobile is being operated at 60 miles an hour.

Where is all the fuel stored, how is it distributed and how much is used in a month at the labs? Answers to these questions are provided by Wilson Y. Hancock. The fuel is stored in 34 underground tanks of 500, 1000, 5000 and 10,000-gallon capacities. These tanks hold 78,500 gallons and soon other tanks will be installed to boost the total to 130,500 gallons; 25,000 gallons are consumed each month.

Hancock displays with pride a system for measuring the amount of gasoline in the underground tanks. This is done by "bleeding" air through the tanks. Each tank is pitched slightly toward one end and has a sump of about one gallon capacity at that end. A tube extends down through the top of the tank into the sump and leads back to a manifold system on a panel in the fuel house. Compressed air is passed into the tube, and the resistance offered by the weight of the gasoline, or "back pressure," is registered on a manometer. Calibration curves on a chart quickly tell the operator how much gasoline is left in the tank. The manifold can also be connected to a small pump to clean waste or dirty fuel from the tank sump. A "sight glass" shows when all the impure fuel has been removed.

A "switchboard" arrangement can sup-

(Continued to page 284)

SUPER DRILL GRINDER

Sharpens round shank drills from 3/32" to 1-1/16" diameter. Grinds Old Drills like new in 4 different drill point angles. Grinds Short, Medium and Long Twist Drills from 1½" up to 11" long, for hand or power grinding wheels.

200,000 IN USE!

Grinds your drills like factory in 25 seconds. Gives perfect center and clearance. Saves drills, time and money. No shop should be without the Super Drill Grinder. Guaranteed to do the work or money back. The Grinder that gives a rounded point!

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New Glider-Kite

TOWS AUTO OR LIFTS LIGHT PERSON

LIFTING WING AREA EQUAL TO SMALL PLANE

Cost Government $108
Yours for $34.50

Not a toy for youngsters. Men with scientific or aeronautical turn of mind get thrill of lifetime with this genuine Barrage Glider-Kite. A "natural" for sky advertising. Took 12 years to perfect. Hundreds used during war to shield convoys. 134 sq. ft. special aircraft fabric. 10' long x 14' wide double wing and tail. Gives enough pull to move car on level ground. Act quick if you mean business. Cost Government $108. You send only $34.50 and we ship F.O.B. complete with spare parts and repair material. Ready made. Assembles easily in 15 minutes. Dismantle in 5 minutes. Or send $10 and we ship C.O.D. for balance. Write Great Northern Kite Mart, Dept. PM-2, North Adams, Mass. (Dealers letterhead inquiries invited.)

A BIG 25¢ WORTH OF TOOL TIPS

● Everything about tools . . . at a glance. More than 2000 views of boring and cutting tools, squares, gauges, jigs, etc. Years of tool experience in one, low-priced book . . . 25¢ postpaid. Write today. Stanley Tools 37 Elm St., New Britain, Connecticut.

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SAY YOU SAW IT IN POPULAR MECHANICS

SAVES MANY ELECTRIC APPLIANCES

NICHROCITE REPAIRS HEATING ELEMENTS IN A JIFFY . . .

Simply overlap ends, apply Nichrocite Paste and turn on current. Used by large utility companies. Trial order, $1.00; 4 oz., $2.50; 1 pound, $8.00.

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BUILD ONE YOURSELF FROM YOUR OLD MOWER

We supply complete attachments that fit any make or size of mower, with or without 1½ H.P. gas engine. Easy to install in less than an hour. No more back breaking mower pushing. Immediate delivery, at low prices, express prepaid.

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You'll be delighted! Complete satisfaction or your money back. Write for

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An Amazing New ADDING MACHINE Everyone Can Afford!

Lowest Price Ever Asked for a REAL ADDING MACHINE

This substantial, professional-looking GUARANTEED machine gives you lifelong, accurate figuring service at an amazingly low price! Pays for itself in errors avoided and time saved. The new "Precise" adds, subtracts, multiplies—with easy stylus operation. No paper tape to bother with. Totals come up on the Polystyrene magnifier instantly, automatically, accurately! Counts up to 99,999.99. Professionally built with internal construction of steel, bronze and brass throughout; Zamac cast metal case, in handsome, two-tone baked spray lacquer finish; number plate is solid bronze, with etched red and black figures for easy visibility. 7" x 5" x 4¾". With complete instructions. Portable, fool-proof, rugged. A real adding machine at a fraction of the usual cost!

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A *Real* BUSINESS-LIKE ADDING MACHINE
Easy to Use
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ADDS! SUBTRACTS! MULTIPLIES!

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YOU RISK NOTHING. Use the "Precise" Adding Machine for 10 days. If you're not completely satisfied, return it for full refund. Every machine is covered by a full year's guarantee for materials and workmanship; free repair during guarantee period. Order today—we'll ship C.O.D., or postpaid on paid orders.

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☐ Ship me one "Precise" Adding Machine
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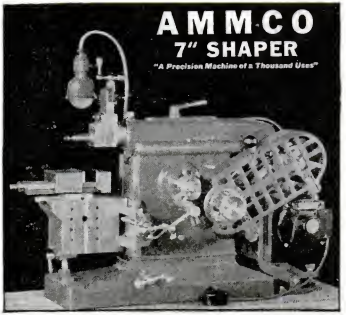

A wide variety of jobs can be done accurately, quickly, easily, and economically on the AMMCO Shaper (7" stroke).

Construction incorporates many features you would expect to find only in larger, more expensive machines ... For example: WAYS of ram, tool head, and front face of the main frame are of the "VEE" type, hand scraped to insure accuracy and long life. Available for stationary installation or as portable unit.

Write today for specifications and prices

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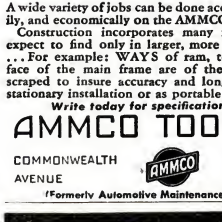
COMMONWEALTH AVENUE — AMMCO — NORTH CHICAGO ILLINOIS

(Formerly Automotive Maintenance Machinery Co.)



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IMMEDIATE SHIPMENT

$3.75 plus 25c shipping charge

Sturdy 1/100 HP motor 1500 rpm. High torque. Drives models, toys, signs, etc. 110 volt, 60 cycle A. C. Height, 3-3/4" Meets U. L. specifications. Shipped complete with cord, ready to run.

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Send ___ motors at $3.75 each, plus 25c for packing, shipping
Enclose check or money order No C O D.s Please.

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WRIST WATCH

Complete with New Style EXPANSION BAND

7 JEWEL $12.95

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Sensational value! Genuine Military wrist watch precision built, split-second timekeeper, your choice of 15 jewel movement for ONLY $16.95 plus tax! Or 7 jewel movement for only $12.95 plus tax. Waterproof, shock-protected, anti-magnetic. Radium dial and hands, easily read in the dark, unbreakable crystal, **red sweep second hand.** Handsome, non-corrosive stainless steel case. Genuine non-corrosive stainless steel expansion bracelet fits all wrists. Order yours today!

SEND NO MONEY! Rush order now stating which watch you want. Pay postman price listed above plus postage and 10% Fed tax. If not delighted, return within 10 days for refund.

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AHOY, GAME-ROOM SKIPPERS!

BUILD THE JOE LANE!

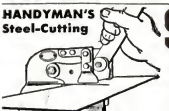
This beautifully detailed, authentic replica of one of the first revenue boats is a real collector's item. Easy to build from clear, carefully drawn plans. A model you'll be mighty proud to display! Complete kit of parts, plans and assembly instructions .. $11.00

SHIP MODELS ILLUSTRATED

The complete guide to modeling. Pictures of all types from clippers to corvettes — actual plans and detailed drawings $2.50

HALESITE YACHT SERVICE Dept. PB Halesite, L. I., New York

HANDYMAN'S Steel-Cutting



SHEAR

Cuts flat steel up to 1/8" thick, with ease. Can be mounted in vise or bolted to bench. Built for hard use by maker of famous "Handnib" Machine Shop tools. EXTRA: Has built-in die for cutting rods up to 5/16" dia. Shipped express prepaid for cash with order. ONLY $27.50

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UTICA TOOLS

PLIERS FOR EVERY NEED

Ask Your Dealer

UTICA DROP FORGE & TOOL CORP.
UTICA 4, NEW YORK

AUTO-LITE Plug Tips

MAKE SURE you have the right spark plug for the type of driving you give your car. Your Auto-Lite Spark Plug Dealer can tell you when plugs are lazy or faulty and when plugs of a different heat range* will give better results. Let your friendly neighborhood Auto-Lite Spark Plug Dealer give you a complete Auto-Lite "Plug-Chek" regularly, at least once every 5,000 miles.

TOO HOT

If the firing tips on your spark plugs are fused or blistered, the spark plugs are operating too hot and may be causing costly loss of power and harmful spark knock.

HOT PLUG

The longer firing tip of this plug dissipates heat slowly and operates at a relatively high temperature. Stop-and-go driving and slow speeds require this type of plug.

*Even though Auto-Lite Spark Plugs are wide range spark plugs, it is still necessary for best results to select the plug whose heat range will be most suitable for the speed and loads required.

TOO COLD

If the firing tips on your spark plugs show deposits of carbon or are wet with oil, the spark plugs are too cold and may be causing slow, difficult starting and high gas consumption.

COLD PLUG

The shorter firing tip of this spark plug dissipates heat rapidly and operates at a relatively low temperature. High speeds and wide open throttle operation require this type of spark plug.

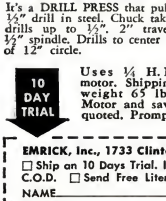
Switch to AUTO-LITE SPARK PLUGS

COMPLETE HOME WORK SHOP The Emrick Universal Woodworker gives you the five most useful power tools in one rugged, compact HEAVY fabricated steel frame. Free running in bronze bearings. Thousands of satisfied users.

It's a LATHE—precision built and easy running. 10" swing over bed, 30" between centers, ¾" main spindle. Face plate, spur center and tool rest included.

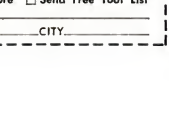
It's a DISC SANDER that cuts fast and clean on edges or surface of any stock. 8" diameter disc takes any type abrasive.

It's a CIRCULAR SAW taking a 6" blade. Arbor takes dado saws, moulding cutters, scratch wheels or buffing wheels.



A high quality 5" EMERY WHEEL is furnished. 4-step cone pulley gives choice of running speeds for efficient grinding.

It's a DRILL PRESS that pulls ¼" drill in steel. Chuck takes drills up to ½". 2" travel. ½" spindle. Drills to center of 12" circle.



10 DAY TRIAL

Uses ¼ H. P. motor. Shipping weight 65 lbs. Motor and saw blade not included in price quoted. Prompt shipment.

EMRICK, Inc., 1733 Clinton St., Kalamazoo 24, Mich.
☐ Ship on 10 Days Trial. I am enclosing $17.50, balance C.O.D. ☐ Send Free Literature ☐ Send Free Tool List
NAME_____
ADDRESS_____CITY_____

ply 32 different fuels to the dynamometer labs. Hundreds of feet of fuel lines extend through service tunnels beneath the floors.

In the road test laboratory are many new car models used in studies of knock rating, acceleration, fuel economy, air-fuel ratios, spark plug performance and other points of vital concern to automotive manufacturers, refiners and car buyers.

The chemical laboratories contain the most modern equipment available for distillation, purification and preparation of organic compounds, physical chemistry studies and analytical work.

The pilot plant, a separate building at the rear, houses a complete 1/100-scale manufacturing setup for tetraethyl lead. Here improvements for the manufacture of this basic antiknock agent are discovered and passed along to the big manufacturing plant at Baton Rouge, La.

Research workers casually refer to the "furnace house" as a point of interest. This contains a small high-temperature furnace where metal bars are placed under stress and terrific heat applied for long periods of time. The results show strength and corrosion resistance of various alloys. Here, also, jet fuels are studied—thus combining two basic problems of jet engines: proper fuels and heat-resistant metals.

Searching for right answers to engine and fuel problems aptly sums up the activities not only in the jet and corrosion furnace lab, but in the pilot plant, chemistry labs, dynamometer rooms, aeronautical lab, the library and right out to the front door of this proving ground for tomorrow's fuels.

As one engineer remarked, it's the answers found in places like the Ethyl Corporation Research Laboratories that "have kept the U. S. a couple of laps ahead of the rest of the world."

Laboratory in Space

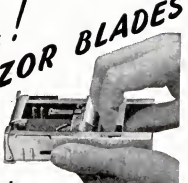
(Continued from page 102)

Herrick figures. "The earth moves around the sun at 18½ miles per second. So, if the rocket is launched in the opposite direction from the earth's travel, at eight miles per second, its net forward speed would be 10½ miles per second.

"After the ship pulls away from the earth its rocket motor could be turned off. The earth's attraction then would increase the ship's speed, pulling it along behind at about 17 miles per second. Gradually the ship would curve in toward the sun and the solar attraction would increase its speed to 23 miles per second. Approaching Venus, the ship's speed would increase

(Continued to page 288)

HONES! and strops! RAZOR BLADES



More shaves, better shaves from every blade

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Strongly built for years of service. $6.50 at leading cutlery stores. If not available locally, we send postpaid on receipt of $6.50. State name of blade used.

Voss Cutlery Co., Inc., 258 Broadway, New York 7, N.Y., Dept. 13

EVERSON "29"

PRICE $11.50

Class "B" Miniature Gas Engine

A high speed power plant for your competition models.

FEATURING — Deep cooling fins — Floating Meehanite sleeve—Per*Mold aluminum castings — Rugged crankshaft precision ground—Open timer—Rotary valve — External parts plated—.290 Cu. In. displacement.

Fully guaranteed against material and workmanship. Bench tested. Engine comes complete with plug, gas tank and fully illustrated instructions less coil and condenser.

Sent prepaid in U. S. for $11.50 or send $1.00 we will ship balance C.O.D.

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PRINT YOUR OWN COPIES with ROLL-A-COPY duplicator

Makes 8½"—11" copies of letters—advertising special forms—of your own devising. Save printing costs. Make your own business forms. Complete with stencils, ink, brush, stylus, correction fluid and instructions. Sent prepaid if money order accompanies your order. Complete **$9.50**

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Plastikpli is sold direct to user where we do not have distribution. Write for color-chart and prices.

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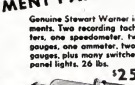
BRAND NEW TANK INSTRUMENT PANELS

Genuine Stewart Warner instruments. Two recording tachometers, one speedometer, two oil gauges, one ammeter, two heat gauges, plus many switches and panel lights. 26 lbs. **$25.00**

SERVO UNIT

For Automatic Pilot. Includes 28 volt D.C. 1/4 h.p. motor, 3 gear hydraulic pump, heating element, etc. Weight 38 lbs. Original cost $1900. **$9.75**



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GUNSIGHT COMPUTER

Contains 27 volt DC motor, 125 ball bearings, over 100 gears, lenses, switches, flexible drive connections, etc. 36 lbs. **$12.50**

RADIO RECEIVER SWITCH BOX

Contains 2 selector switches, 2 multi-terminal receptacles, phone, jacks, potentiometer. 3 lbs. A real buy. **$2.25***

RADIO SWITCH BOX

Contains 2 windowed selector switches, multi-terminal receptacle and toggle switch. 2 lbs. **$1.75***

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6-1/2" diameter luminous face, built in magnetic correction. **$29.50**

25 TON BRONZE SCREW JACKS

Excellent for sagging buildings. **$9.50**

1/4" ELECTRIC HAND DRILLS Operates on 12 to 24 volts, a.c.-d.c. 2 lbs. **$8.50**

3 WHEELED DRUM DOLLIES 1000 pound capacity. Weight 55 lbs. **$7.50**

OXYGEN TANKS Carries 400 lbs. pressure, 200 cu. in. capacity. Weight 5 lbs. **$1.95***

MICRO SWITCHES 28 volt 10 amp. feather-touch operation. **75¢***

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BUILD THIS FAST FREEZER

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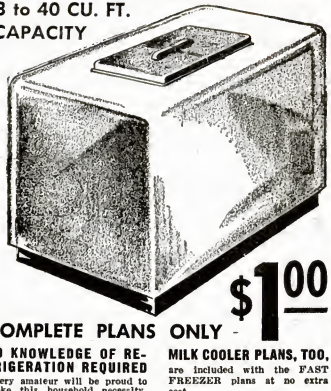

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MILK COOLER PLANS, TOO, are included with the FAST FREEZER plans at no extra cost.

Send $1.00 bill, check or money order for complete plans and catalog. Canada $1.10. Satisfaction guaranteed.

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Amazing New KLIK-RITE

BALL PEN

GUARANTEED to Write for Years Without Refilling

Name in 23K Gold FREE

A real BALL PEN! Works and performs exactly like highest-priced pens—PLUS amazing new "click-it-to-write" . . . "click-it-to-park-it" feature—PLUS your name in 23K gold—all for only $2.98! Writes dry with waterproof ink—no blotter needed. Cannot leak. Writes anywhere . . . even under water. One piece—no cap to fuss with or lose. Touch the button on top & ball point "clicks" out to write. Another touch and the point "clicks" back into the barrel. A slim streamlined beauty—lightweight . . . COMPACT! Factory guaranteed.

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Rush order today. PRINT NAME to be stamped in 23K Gold. Pay postman only $2.98 plus few cents postage on delivery. Or send $2.98 with order and save postage. If you are not delighted, return pen within 10 days for your money back. Order today!

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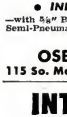

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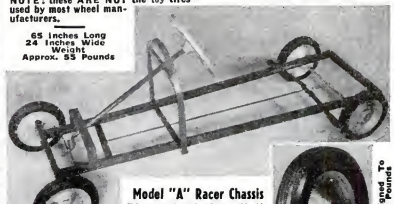

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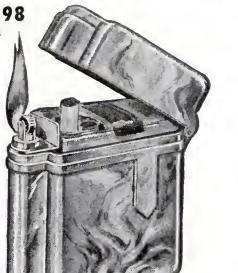

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to 30 miles per second because of the gravitational pull of that body. Venus itself travels ahead at nearly 22 miles per second and so the net approach speed would be about the same as that of the take-off.

"The sun's gravitational pull would predominate during most of the trip. Disturbances by the earth, the moon, Venus and other bodies would have to be allowed for, especially at the start and the finish. The exact orbit would be precomputed for all stages of the journey and this would be checked en route by celestial observations. The edge of the earth or the moon plus a star, for example, could be used in obtaining fixes. If the rocket got badly off course it would miss its target and probably would drift around the sun until the end of time."

Minor corrections in speed and direction likely could be made by blasts from rocket nozzles projecting at different angles.

Venus is a question-mark planet. Almost as large as the earth and with a gravitational pull about 14 percent less, its surface is always hidden by thick clouds composed in part of carbon dioxide. Oxygen and water vapor haven't been detected in the cloud layer. No one knows what lies under the clouds or whether the surface of Venus is solid or liquid. Some suspect that the surface consists of a sea of formaldehyde. The temperature might be equable or it might be above the boiling point of water. In other words, we don't know whether life as we know it could exist on Venus.

If and when a space ship is built, other problems will immediately arise. Its crew would have no inkling of what they would find until after they had plunged through Venus' cloud curtain. If they landed safely they would have to begin manufacturing, at once and from whatever materials they could find, an atmosphere similar to ours.

Not for more than a year would Venus and the earth be in positions suitable for the return trip. In the meantime the crew would need to continue to breathe, eat and drink. They would have to refine sufficient fuel for their return from the elements available. They would need to work out the navigation problem of returning home against the attraction of the sun. They would need derricks and other apparatus for re-aligning the craft for launching. They might even need a ground handling crew.

Obstacles like these make interplanetary travel appear almost as fantastic today as the idea of talking great distances over metal wire would have seemed several centuries ago. But the miracle of the telephone is old stuff now and in 1947 scientists only say that they don't yet command the magic to make space travel practical.

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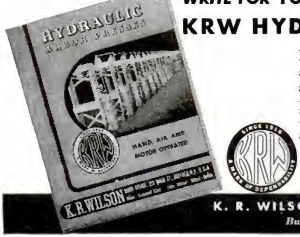

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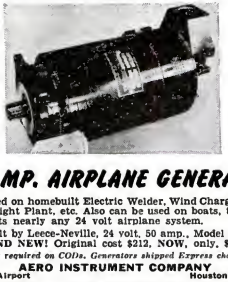

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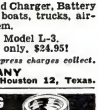

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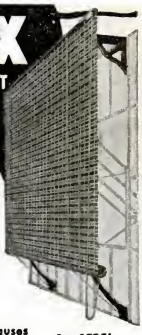

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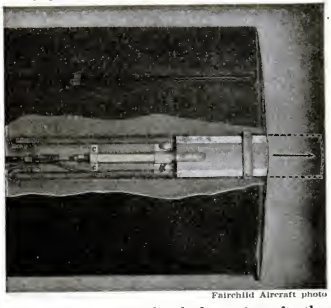
Experimental Wing Tip Aileron Tested for Pilotless Aircraft



Fairchild Aircraft photo

To better control pilotless aircraft, the Navy is testing a retractable aileron which protrudes from the wing tip instead of the trailing edge. Housed completely inside the wing, the aileron is extended by compressed air forced into a tube and plunger attachment and retracted by springs. Orthodox ailerons are moved up and down but remain fixed at the rear of the wing.

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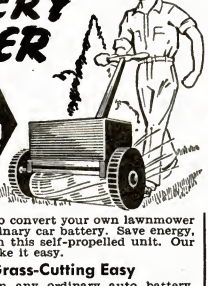

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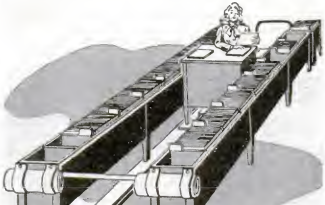

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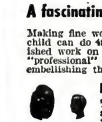

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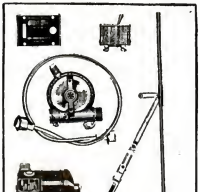

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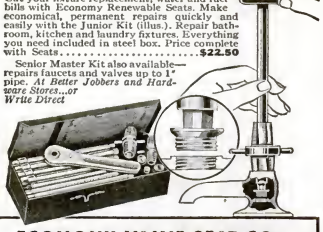

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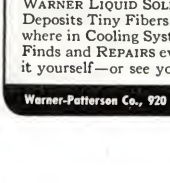

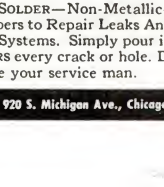

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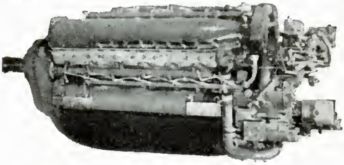

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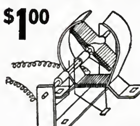

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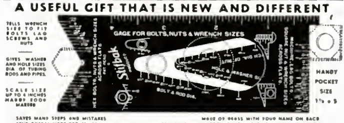

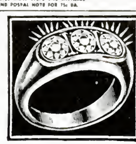

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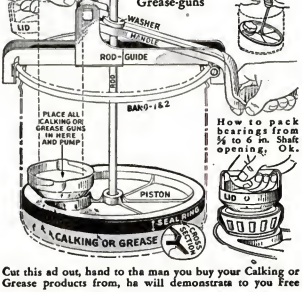

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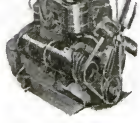

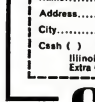

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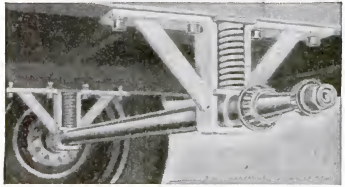

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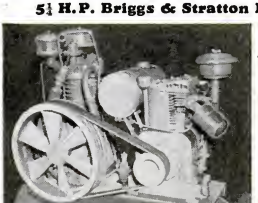
5½ H.P. Briggs & Stratton Engine



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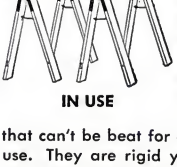

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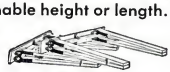

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Mfgd. to U.S. Navy Standards! (Alignment guaranteed to .001") Brand new glasses. Dust proof! Climate proof! Individual eye adjustment. Instant focusing. Coated optics insure sharp, clear images! Ideal for long range hunting, yachting, watching planes, etc. This magnificent 7 power 50 mm. Navy Binocular gives better detail, heightening image contrast. Complete with carrying case only $135.00 plus 20% Federal tax.

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7x50 German Dienstglass. Used.	145.00
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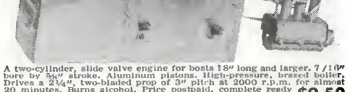

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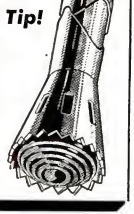

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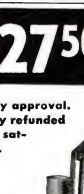

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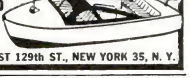

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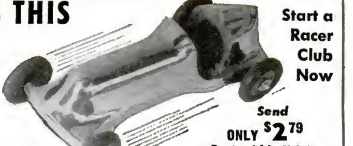

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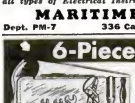

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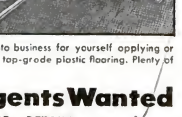

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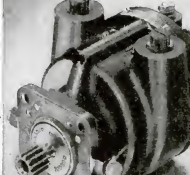

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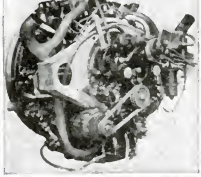

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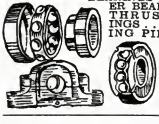

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You can do a countless variety of jobs with the Duplex—sanding, sharpening, grinding, sawing, and many more. Its chuck takes tools with ¼", ⅛", and 3/32" shank — ordinary handgrinders usually handle only up to ¼" shank tools. A full 1/14 HP motor has plenty of power for heavier jobs. Long-life bearings guarantee trouble-free service.

The Deluxe Duplex Grinder Kit (illustrated above) includes the Duplex Grinder and 27 different tools and accessories, packed in a permanent case of handsome polished wood. Complete as described—$27.50. Standard, 9-accessory kit, without case—$19.75.

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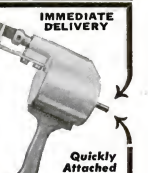

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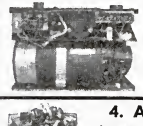

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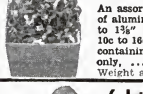

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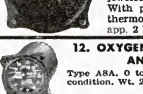

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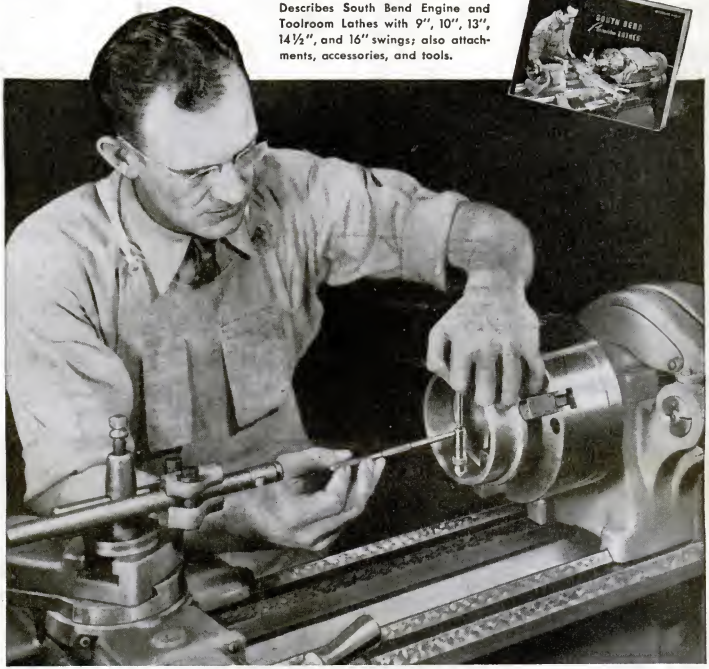

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NED DAY

...RATED BY MANY EXPERTS AS THE GREATEST MATCH BOWLER OF ALL TIME!

DURING HIS CAREER NED HAS ROLLED 27 PERFECT SCORES OF 300

I SEE YOU'VE MET HIM, TOO!

...IN HIS FIRST GAME THE CURLY-HAIRED WEST ALLIS, WIS., WONDER SCORED A LOWLY 63!

DO THEY NAIL THOSE PINS DOWN?!?

...BUT SINCE THEN HE'S GARNERED THE NATIONAL MATCH GAME CHAMPIONSHIP 5 TIMES AND WON MORE TITLES THAN ANY OTHER TEN-PIN STAR.

KEEPING HIS SCORE IS A CINCH!

HE FEELS SHARP!

...POURING STRIKE AFTER STRIKE INTO THE 1-3 POCKET !!

...TWICE HE HAS ROLLED 33 CONSECUTIVE STRIKES IN MATCH PLAY—NEARLY ENOUGH FOR THREE PERFECT GAMES IN A ROW!

HE LOOKS SHARP!

...TRAINING AMBITIOUS BOWLERS IN THE FINER POINTS OF HIS FAVORITE SPORT...

YOU MUST HAVE DONE SOMETHING WRONG!

...NED ESTIMATES THAT HE HAS INSTRUCTED A HALF MILLION PLAYERS AND TRAVELLED A MILLION MILES IN EXHIBITION AND COACHING TOURS!

SMOOTH AS A BOWLING BALL!

look SHARP
feel SHARP
be SHARP

use **Gillette Blue Blades** with the SHARPEST edges ever honed!

● You *look* sharp for you enjoy the swellest shaves ever. You *feel* sharp because they're refreshing and give you a lift. You *are* sharp for you get far more shaves per blade and save money. Ask for Gillette Blue Blades.

Gillette BLUE BLADES

5 for 25¢

HE IS SHARP!

...NED DAY GETS THE SLICKEST SHAVES IN THE BOOK AND SAVES MONEY, TOO FOR HE ALWAYS USES **GILLETTE BLUE BLADES** WITH THE SHARPEST EDGES EVER HONED! TAKE IT FROM HIM, THAT'S THE WAY TO SKIM OFF STUBBLE IN JIGTIME WITH PERFECT COMFORT. YES, AND REMEMBER—

DOUBLE EDGES MEAN DOUBLE ECONOMY!

ENJOY BOXING FRIDAYS AT 10 PM EST OVER ABC NETWORK. GILLETTE'S CAVALCADE OF SPORTS ALSO AIRS WORLD SERIES AND OTHER CLASSICS YEAR ROUND.

Gillette Safety Razor Company, Boston 6, Mass.

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EXPERIENCE IS THE BEST TEACHER!

EXPERIENCE TAUGHT MILLIONS THE DIFFERENCES IN CIGARETTE QUALITY!

R. J. Reynolds Tobacco Company
Winston-Salem, N. C.

Result: *Many millions more people found that they liked Camels best.*

IT'S ONLY a memory now, the war cigarette shortage. But it was during that shortage that people found themselves comparing brands whether they intended to or not.

And millions more people found that the rich, full flavor of Camel's superb blend of choice tobaccos suited their Taste to a "T." And that their Throats welcomed the kind of cool mildness Camels deliver.

Thus the demand for Camels grew so great that today more people are smoking Camels than ever before. But, no matter how great the demand, this you can be sure of:

Camel quality is not to be tampered with. Only choice tobaccos, properly aged, and blended in the time-honored Camel way, are used in Camels.

According to a recent Nationwide survey:

MORE DOCTORS SMOKE CAMELS

than any other cigarette

When three independent research organizations asked 113,597 doctors—What cigarette do you smoke, Doctor?—*the brand named most was Camel!*